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THE

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IMPORTANT NOTICE.

We have much pleasure in announcing that J. A. BERLY'S UNIVERSAL ELECTRICAL DIRECTORY will, in future, be published at 4/-, and forwarded free, within the Postal Union, at that price.

The same care and attention will continue to be bestowed upon the editing of the work as heretofore, and nothing will be left undone in order to keep it in the position it has always held, as "The leading Electrical Trades Directory."

While reducing the price, we are confident that increased sales will fully recoup us, and at the same time we believe the policy thus inaugurated will be received by our numerous subscribers and advertisers with general satisfaction.

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AN ELECTRICAL ENGINEER'S APPRENTICE.

ELECTRICAL engineers, having articled pupils, will find much to reflect upon in the judgment given by Mr. Justice Romer in the action, Uniacke *v.* Scott, which came before him on the 5th inst.

In this case, which was briefly referred to in our "Notes" of last week, Mrs. Mary Augusta Uniacke, a widow, claimed against the defendant, Mr. Ronald Augustus Scott, the repayment of a premium of £150, which she had made over to him in December, 1889, for the apprenticeship of her son, F. W. P. Uniacke. For that sum the defendant had agreed to receive Uniacke as an out-door apprentice in the art of an electrical engineer. The apprenticeship was to extend over a term of three years.

For the first year a payment of 7s. 6d. per week was to be made; for the second year, 10s. per week; and for the third, 15s. per week.

The action originated in the alleged breach of the deed by the defendant. It was urged that he had not, at any time, properly taught or instructed his apprentice, or caused him to be properly taught or instructed, in the art or business of the electrical engineer. Also, that the defendant, in September, 1890, without due cause, precluded him from attending, and refused to allow him to attend, at the workshops and place of business of the defendant for one month. And, again, that the defendant had discharged him. A claim was therefore made by the plaintiff for a return of the premium, or, in the alternative—damages.

From the summing up of the case by Mr. Justice Romer, it appears that the defendant had only seven or eight workmen, properly so called, and a great number—about sixty—of apprentices. His Lordship was convinced that the evidence entirely justified the claims of the plaintiff. The son was not taught, nor attempted to be taught, to any substantial degree, the art of an electrical engineer. He was only employed in handiwork which saved the whole or part of a workman's wages. For nine months he had been kept at two sorts of work only, viz., filing and fitting brass rods, and attending to machines for making brass screws. No real instruction in electrical engineering had been given at all. The defendant was not justified in keeping an apprentice for nine months at the mechanical work referred to. The lad appeared to have been taught nothing. The defendant, apparently, had left the business to the manager; the manager to a foreman; and the foreman seemed to have looked on the pupil only as a person employed to do mechanical work.

For some inattention the salary of the apprentice was reduced by the foreman by 25 per cent. That was an ample punishment; but, on the lad complaining to the defendant, the defendant further ordered that he was not to be allowed to come to the works, or receive any salary or instruction,

for a month. That decision, his lordship considered, was unjustifiable.

The damages were assessed at £120, which was not to be considered as a return of premium. The defendant was further ordered to pay the costs of the action; his counter-claim against the plaintiff for damages being dismissed with costs.

We should be glad to think this an isolated instance of the treatment received by apprentices of electrical engineers. Unfortunately facts assure us that it is characteristic of too many.

The difficulty of teaching a lad electrical engineering must be acknowledged very great. It implies theoretical as well as practical tuition, and includes an acquaintance with mechanical as well as electrical questions. For electrical engineering is not a craft pure and simple; but something between an art and a profession, a science and a trade. Consequently it cannot be acquired wholly by "induction" through a working foreman; but needs, in addition, a specific training from a theoretical man.

It is no small undertaking, therefore, to teach electrical engineering, in any case; and with lads just leaving school it is inclined to be specially arduous.

Yet if a man, sufficiently satisfied with himself all round, stipulates for a certain sum to do it, he ought to exert himself, and with some sort of conscientiousness, self-respect and honour, achieve what he can for the lads committed to his charge. He should, personally if possible, or by some well-chosen deputy, instruct them in the theory as well as the practice of their work. It is exceedingly important that the work should be *progressive*, and have a distinctive electrical tendency about it.

We could give instances of lads, nominally under electrical engineers to be taught the business, who were kept at carbon drilling and burring up brass castings for months. At the end of their course, what did they know of electrical engineering? Ohm's law was a romance to them, and the simplest dynamo machine a mere myth.

Of course we recognise that such mechanical work must be done, but there are plenty of poorer youths and men to whom this class of employment belongs by right; and they should receive a fair rate of pay for it. Surely it is beneath contempt to deny these men their means of living by putting apprentices to fill their legitimate place. It stints the workman, it discourages the apprentice, and brings discredit upon the employer and his profession.

A most worthy example is set by those excellent electrical firms who offer to pay the fees of their apprentices for attending evening courses at local technical schools, this might be followed with benefit, generally, in the case of articled pupils.

Towards further improvement in the present system, we would suggest that periodically the apprentices should be conducted round the works by the engineer, in a similar manner to the way in which medical students are taken through the wards. New applications could then be shown, and their theory demonstrated.

Above all, it is necessary for the employers to recognise their responsibility to the lads, their parents, and the electrical world. They should not allow themselves to degenerate into monetary *guinea-pigs*.

"THAT STUFF CALLED USEFUL KNOWLEDGE."

WE have often felt called upon to enter a protest against the inaccuracies and misleading tendency of some of the so-called "popular science," which unfortunately is often widely distributed amongst a class of readers who are quite incapable of discrimination. Egregious errors are propagated which will be caught hold of and accepted as truths in every direction, with the result that false notions and prejudices take the place of knowledge.

It cannot be supposed that this variety of "science" is propagated by properly qualified men, or (which is another thing, unfortunately) by men who have passed through some of those elaborate systems of training upon which we are prone to pride ourselves as a nation. Such propagation is probably the work of some of those gentlemen in the reading room of the British Museum, who disturbed Thomas Carlyle in his studies, and of whom he said, in giving evidence before the commissioners appointed to inquire into the constitution and management of that illustrious institution many years ago: "The use they make of the library is to assist them in drawing up articles for compilations, dictionaries, and encyclopædias, and the stuff called '*Useful Knowledge*.' They are a thick skinned race."

In the current issue of the *Philosophical Magazine*, Mr. Charles Tomlinson, F.R.S., has some interesting remarks suggested by a popular article on the *Ignis Fatuus*, which was recently submitted to him from a book on "popular science" which has passed through many editions. The case in question was a typical one of "knowledge run wild," and Mr. Tomlinson treats it with scant mercy. He shows, moreover, by quotations on the same subject from certain standard encyclopædias, that when certain writers "write popularly" there is often more useless ignorance than useful knowledge displayed.

Writers in encyclopædias and popular guides to science have abundant sources of reliable information, if they will only take the trouble to look in the right places.

Mr. Tomlinson complains that there is a good deal of indifference in private life as to whether science is taught or not, or how it is taught. In some cases this indifference is based upon ignorance of the importance of such knowledge; in other cases there is a decided prejudice against it, because it is supposed to conflict with certain theological dogmas. Even when such prejudices are absent, there is a want of discrimination in the selection of text-books for the young, and it is often a mere chance if a book written by a competent hand is selected.

How can it, we ask, be wondered at? Until science enters more seriously the *curriculum* of ordinary middle-class education such indifference must remain, and such "popular science," as we have been speaking of, will continue to be bought and read. Let the rising generation be accurately trained in first principles, and no publisher will find it worth his while to issue any more of that "stuff called useful knowledge," unless the titles of such books be supported by their text.

We heartily endorse Mr. Tomlinson's observation, that in our middle-class schools science and modern languages require to be more systematically studied than they are at present, if we, as a nation, would maintain our commercial and manufacturing position with respect to other countries.

Note on the Theory of the Voltaic Cell.

As we have already announced, Mons. H. Gilbault has communicated to the Paris Academy of Science, on October 12th, the results of an important research upon the work of the electromotive force of cells under pressure. In this research he verified by experiment a formula which was deduced, he says, from some observations of Mons. H. von Helmholtz in his theory of free energy. Mons. Darboux, however, points out in the *Comptes Rendus* for October 26th, that this relation is deduced, not from that stated to exist by von Helmholtz between the electromotive force of a cell and the free energy—a relation which is incomplete—but from the more complete relation observed by J. W. Gibbs between the electromotive force and the total thermodynamic potential, and which was published some time before the memoirs of von Helmholtz. This relation may be studied in *La Lumière Electrique*, in a series of articles by Mons. J. Montier, published in 1884, or in Mons. Gilbault's *Potential Thermodynamic*, p. 117, or his *Leçons sur l'Electricité et le Magnétisme*, Vol. i., p. 548.

Note on the Theory of the Oscillations of Hertz.

THERE is an important paper of a mathematical character in the *Comptes Rendus* for October 26th, by Mons. H. Poincaré upon the theory of the oscillations of Hertz. In the theory of Maxwell the equations which ought to satisfy these oscillations exhibit several useful properties to which he calls attention, because they are able, not only to facilitate the calculation of the period of these oscillations, but especially because they permit the extension of an exciter, whatever the results of Hertz (Wiedemann, V. xxxvi.) relative to the state of the electro-magnetic field, and to the radiation of the energy. Mons. Poincaré has already had something to say concerning this in the *Annales de Genève*, in which he gave some account of his experiment with a circular resonator. It would scarcely be within our province to follow Mons. Poincaré through the purely mathematical reasoning which he uses in this note, but we may observe that he fully succeeds in pointing out some highly interesting relations which we do not think have been hitherto observed.

Messrs. Woodhouse and Rawson's Report.

WE regret to see from the report of Woodhouse and Rawson United, Limited, that the directors contemplate adding to their already heavy responsibilities in the matter of the Elmore process. They have entertained proposals for a further development in other countries at an early date. The reason for doing so is that the technical statements made have been proved by actual results. It would certainly be of interest to know what are the technical statements which have been proved; but it seems to us that the directors should hesitate to embark capital, or to induce others to embark capital, in further developments until the commercial statements have also been proved by actual results.

The Use of Small Motors.

AN esteemed contemporary recently gave vent to the opinion that there is no demand for, and at present but little likelihood of, the extended use of small electric motors for industrial purposes in this country; that is, worked from a central station supply. The principal reason urged appears to be that, according to our contemporary's methods of calculation, the horse-power hour would cost 4·4 pence with electrical energy at 5d. per unit, as against one penny an hour with a gas engine. It is considered as being very improbable that any motors running nine hours a day and yielding more than four horse-power can be used, unless under very exceptional circumstances. The convenience and ease with which an electric motor can be started and stopped are admitted, probably also the writer will allow that the electrical energy consumed can be made proportional to the work done; but does he really seriously assert that small power gas engines can be worked at the price stated? Does he not recognise the fact that when a gas engine employed in intermittent operations is once started it is generally allowed to run idle when the load is off, rather than have the bother of re-starting? Is not gas being consumed during these periods just as when work is being performed, and does not a gas engine require frequent cleaning, considerable oil, a water supply, and numerous other trifling attentions which would bring up the cost of the horse-power hour to something approaching, if not quite as much, as that quoted for electricity? Indeed, it seems that it had already been intimated to our contemporary that its leading—or, rather, misleading—article was clearly based on erroneous premises, for in its last issue it makes a semi-apology for the untenable arguments employed.

The Latest Puzzle in Electrical Phenomena.

The *Daily News* last week gave a very thrilling and exciting account of the remarkable feats performed by an American lady in the presence of a number of doctors and well-known scientists, including Profs. Crookes, Perry and Dr. Lodge. Our contemporary credits Mrs. Abbott with bringing from the United States the latest puzzle in electrical phenomena, for she modestly ascribes the seemingly incredible feats which she accomplishes to electricity or to animal magnetism. Her peculiarity lies in her marvellous strength, although there was no unusual muscular development in her arms or shoulders, neither was any strenuous exertion displayed by her. It was impossible for four men to lift her from the floor, and she remained apparently immovable by any other strength than her own. In return for their exertions thus fruitlessly exercised, Mrs. Abbott lifted four gentlemen, packed somehow on a wooden chair, without any apparent undue exertion. Regarding these mysterious actions Dr. Lodge wrote to the *Daily News* on the 8th inst., in which letter he states that it was half-suggested in their description that the surprising feats were supposed by those present to be attributable in some occult way to electricity or magnetism, and as he was present at the time, he thought it incumbent on him to state that, whereas the feats themselves were, on the whole, very fairly described in the *Daily News* article, there was, in his opinion, not sufficient ground for believing them to be accomplished by anything more abnormal than the extraordinary muscular power and skill of a small woman in good training. Profs. Crookes and Perry also disclaim that the feats witnessed were in any way attributable to animal electricity or magnetism which the lady may have possessed in a special degree, but we can well understand how it might be possible to bring electro-magnetism to the assistance of the performer in the lifting and non-lifting experiments.

The Art of Electric Lighting.

WE have in our possession copies, certified to be true and correct, of the original specification and drawing remaining on record in the Dominion of Canada Patent Office, No. 3,738, of August 3rd, 1874, and granted to Henry Woodward and Matthew Evans. The patent is entitled "Improvements on the Art or Process of Obtaining Artificial Light by Means of Electricity." It is of so interesting a nature, considering the credit which has been given to Sawyer-Man, Maxim, and Edison, that we purpose reproducing all or part of it in our next issue. The extravagant claims which have been made on behalf of the "Wizard of Menlo Park" for being the first to see the advantages of parallel working will perhaps be considerably modified when the drawings of a number of Woodward and Evans lamps in parallel are shown.

A NEW METHOD OF ELECTRO-PLATING WITH ALUMINIUM.

THE essential features of a new system of electro-plating with aluminium are as follows :—

A solution of ammonia alum in warm water is prepared, containing 20 per cent. of alum. To this is added a solution containing about the same quantity of pearlash and a little ammonium carbonate. The mixture results in effervescence, and in the deposition of a precipitate ; the latter is filtered off and well washed with water.

A second solution of ammonia alum, containing 16 per cent. of alum and 8 per cent. of pure potassium cyanide, is now prepared warm and poured over the precipitate previously obtained, the mixture being then boiled for 30 minutes in a closed iron vessel, jacketed to ensure uniformity of heating.

The proportions suitable in the above solutions are as follows :—

First alum solution :—		
Ammonia alum ...	2	kilogrammes.
Warm water	10	„
Pearlash solution :—		
Pearlash	2	„
Warm water	10	„
Ammonium carbonate	8—10	grammes.
Second alum solution :—		
Ammonia alum ...	4	kilogrammes.
Warm water	25	„
Potassium cyanide ...	2	„

At this stage about 20 kilogrammes of water are added, and about 2 kilogrammes more of potassium cyanide, and the whole is kept on the boil for about a quarter of an hour.

The liquid is then filtered from the precipitate, and is now ready for use in the electrolytic bath.

The anodes are perforated or slotted plates of aluminium, arranged so that they can be conveniently raised or lowered. The cathodes receive the deposit.

The anodes and the cathodes are connected respectively to the terminals of a battery or of a dynamo machine, and the current is thus transmitted through the bath, which is kept throughout the operation at a temperature of about 80° to 150° Fahrenheit.

By attaching to the aluminium anode pieces of other metals, *e.g.*, gold, silver, nickel, copper, &c., the tint of the deposited metal can be somewhat varied. When the deposit presents a grey tint it is brightened by dipping the plated article in a solution of caustic soda, which has also the effect of impeding oxidation.

GALVANOPLASTIE.

ONE of our French contemporaries, *Le Journal des Applications Electriques*, has recently been arguing the advantages of "galvanoplastie" over the common method of casting works of art from the mould.

When a work of art is to be produced, say, in copper, it has first to be fashioned by the artist in clay, then a mould is taken and used for obtaining the cast ; finally, the cast has to be chiselled, scraped, and rubbed down until it often loses very seriously the "touch" of the original artist, and may even be deprived of much of the inspiration which may have listinguished it in the clay.

Now, with "galvanoplastie" the metal can be made to faithfully copy every line—every shade of form, however delicate—with the utmost precision ; and therefore it would seem to be a much more suitable method of perpetuating works of art.

It has been argued that galvanoplastic metal is not coherent enough or strong enough to stand any length of time, but that is an error and based upon no legitimate grounds. Hydraulic experiments have proved that whereas a sphere made of galvanoplastic copper, filled with water, and subjected to 20 atmospheres pressure, does not allow any liquid to exude, even when the thickness is half a millimetre ; yet cast copper of the same thickness under the same pressure does allow the liquid to pass. And Wurtz has obtained some very clinching results from a series of comparative experiments performed on cast and deposited copper. He obtained the following values of the density :—

Galvanoplastic copper ...	8·905—8·910
Cast copper	8·780—8·830

This superiority of density is obviously of great advantage.

Finally, the deposited copper is pure, whilst the cast metal is not likely to be, hence the latter will suffer more by reason of the corroding action of the atmosphere ; and this is a point of the greatest importance in a work of art such as a statue.

The cheapness of the deposition method over that of the cast can be easily demonstrated, and the wonder is that artists do not insist upon, and buyers do not prefer this galvanic method to the old method of casting. In France the superiority of it is rapidly being recognised. Here are some instances in which it has been applied with success :—

Bas-reliefs of the Trojan Column, bas-reliefs of the Arc de Triomphe de Constantin, Paris. Statue of Notre Dame de la Garde, at Marseilles, 9 metres in height, 4·5 mm. thick, weight 3,500 kg. Statue of Milon de Crotone, by Puget. Statue of Ariane, by Millet. Various statues by Bary, Caïn, Hiolle, Schœneward and Franceschi, Gumery, Thomas, Crank, Canier-Bellense, Lepère, Cordier, &c.

In this country, and especially in London, where the atmospheric influences are perhaps the worst in the world, it is not a little astonishing that so little attention has been given to a method of reproducing works of art which would be less affected than is usually the case. The Embankment has been waiting for its statuary for years. Is it that we are a people who care nothing for these things ?

ELECTRICITY IN AUSTRALIA.

[FROM OUR OWN CORRESPONDENT.]

SEPTEMBER 7th was the last day on which tenders for the street lighting by electricity of the City of Adelaide could be accepted, and the day dawned and waned without a single tender coming before the committee appointed to receive and deliberate upon the expected applications for permission to light the "City of Churches." The only communication laid before the said committee was a letter from the Brush Electrical Engineering Company, absolutely refusing to tender under the required conditions. As the Brush Company had been specially asked to tender, their letter must have been a severe shock to the Adelaide Council. The reason for the scarcity of tenders will be apparent by a perusal of a few of the salient requirements, extracted from the specification, which I append :—

"The Corporation of the City of Adelaide hereby invite tenders for a term of five years, with the right to extend the term to seven or ten years, at the option of the Corporation, for lighting by electricity the whole of the city, comprising North and South Adelaide, together with all roads leading to the outer boundaries of the city, as shown on plan. The whole area of the city comprised within the outer boundaries is about $5\frac{3}{4}$ square miles.

"Alternative tenders are invited for lighting the city with :—(*a*) 20 arc lamps of 1,000 candle-power each, and 700 incandescent lamps of 30 candle-power each ; (*b*) 50 arc lamps of 1,000 candle-power each and 1,000 incandescent lamps of 30 candle-power each.

"The arc lamps to be swung on mast arms and poles, to be approved by the corporation, at least 35 feet from the road surface.

"The main wires for either system not to be less than 20 feet from any roadway, and carried on neat iron posts, to be approved by the corporation, allowing from 27 to 30 posts to the mile.

"Tenderers will be required to provide one-fourth more power than that used by the electric light station, in order to ensure a reliable, steady and perfect system of street lighting under all conditions of weather.

"Tenderers will be required to provide for the most perfect and modern system of electric lighting, giving the name of the system proposed to be used by them, and to estimate

for the whole of the works to be done, to be of a perfect and complete description of installation in every particular, and to work and maintain in good order the entire system during the continuance of their contract."

The "conditions of contract" follow, and amongst these are the following :—"The contractor must satisfy himself of the correctness of the information of every kind contained in the foregoing specification and the plans of the city, as the council will not be responsible for, nor will the contract be affected in any way by, any errors or omissions that may be found in such documents after the works have been contracted for, &c., &c."

"The city surveyor may require the dismissal, within 24 hours, of any overseer, foreman, workman or other person employed on the works, and in the event of the contractor refusing or neglecting to comply with such requisition, the city surveyor may stop the works until such dismissal is carried out."

"The contractor, on receiving a written notice from the city surveyor, shall from time to time suspend the whole or any portion of the works as may be directed, and the contractor shall have no claim for loss or damage on this account, until after and from the expiration of 30 working days from the date of such suspension, and such suspension shall in no wise vitiate the contract."

"The whole of the works shall be completed and fit for efficiently lighting the city within six calendar months after the acceptance of the tender, &c., &c."

Some of the above conditions seem rather stringent, but the gem of the collection is the following, relating to right of purchase :—"The corporation shall have the right at any time during the term of the contract, or any extension thereof, to purchase the whole of the works and installation as a going concern, either with or without all or any patent or other rights (if any) appertaining thereto, on giving to the contractor three calendar months' notice in writing of such intention, on payment to the contractor of an amount to be mutually agreed upon, or in case of difference to be ascertained as follows, that is to say :—Two arbitrators shall be appointed by the council and two arbitrators by the contractor, and matters relating to such purchase shall be submitted to the decision of such arbitrators, and in all respects such arbitration shall be conducted in accordance with and under and subject to the Railway Clauses Consolidation Act, No. 7 of 1847, or as near thereto as the circumstances of the case will permit ; Provided that the corporation shall not be compelled to abide by the event of the award, if the said corporation shall give to the contractor one calendar month's notice in writing to that effect, and in such case the contractor shall within three calendar months from the expiration of such notice, or the termination of his contract which shall last happen, remove the said works, and all plant and posts belonging to him, and forthwith make good the surface of the roads, footways, or ground injured or disturbed by such removal, &c. . . . And provided always that the said corporation shall pay the costs of reference and award, and all costs and charges incidental thereto."

"In case of any difference or dispute between the city surveyor and contractor, the same shall be referred to the City Council, whose decision shall be final."

It is not very long since the very same thing occurred at Hobart. July 1st was the date appointed for the receiving of tenders for the lighting by electricity of the city of Hobart, and not one single tender was received. Some of the conditions are quite on a par with those in the Adelaide specification. The plant is specified for as follows :—"(*a*) 300 (more or less) incandescent lamps of 20 actual candle-power, or their equivalent candle-power, distributed throughout the city in such places within the city boundaries as the corporation may point out ; or (*b*) eight iron towers with six 2,000 nominal candle-power arc lamps in each tower. Each tower to be 100 feet high, and such towers are to be erected on such spots within the city as the corporation shall direct in writing. Tenderers are invited, if they think fit, to suggest in their tenders any spots suitable in their opinion for their towers. Trotter's dioptric shade, or some other equally effective contrivance, shall be used for arc lamps, to prevent dark shadows and to unify the illumination ; and on no account must the thick opal globes, which absorb a large proportion of the light, be used for any of the arc lamps. (*c*) Any combination of the above two systems, or any other system or combination giving candle-power equal to that stipulated under heading (*a*). But for the purpose of any combination of the systems, (*a*) and (*b*), 60 incandescent lamps are to be deemed equal to one tower of six 2,000 nominal candle-power arc lamps."

Tenders are stipulated for as being for an annual payment at so much per lamp, the contract to extend over a period of five years ; at the end of the five years the corporation is to have the right, on giving to the contractor not less than 12 calendar months' notice in writing before the end of the said five years, to purchase the plant, and the price to be paid therefor to be specified in the tender. If the corporation does not desire to purchase the plant, the contractor at the end of his five years' contract must clear out everything within one month. Or if the corporation does not purchase, the contractor shall have the option of continuing for another period of five years, providing he states his intention of doing so not less that ten calendar months before the end of his contract. At the end of the second period of five years the same conditions prevail as to purchase, but in the event of the non-purchase by the corporation, the contractor is not to be allowed to go on for a further period. In ascertaining the purchase money to be paid by the corporation for the plant at the end of the second contract period, the installation is to be valued as a going concern ; but no sum is to be included in the purchase-money as representing goodwill, &c.

There are a lot of clauses with regard to towers, raising and lowering gear for arc lamps, painting towers, cut-outs for arc and incandescent lamps, wires and poles, dynamos, insulators, additional lamps, spare lamps, &c.

The use of water-power was suggested, and two reports are appended to the specification, one from Dr. Stern, of the Ganz Company, and one from Mr. James, the city engineer. The available water-power seems to be from these reports about 90 actual horse-power ; and, in Dr. Stern's report, it is proposed to place the central station at a distance of 2½ miles from the centre of distribution, and use a high-tension alternating current system. Dr. Stern estimates the cost of the plant for 300 incandescent lamps of 25 candle-power at £8,000, and the cost per annum £1,650, or £5 10s. per lamp per annum ; the actual water-power being supplied by the corporation free of charge.

The Brush Electrical Engineering Company have nearly completed the lighting of Horderu's, the "universal provider." This installation when completed will, I think, be quite the largest private installation in the colonies, with a total of 1,500 16-C.P. lamps. The lighting of the new building lately erected is now completed with 400 lamps, and the old building is nearly finished. The Williamson Electrical and Engineering Company have supplied the engines and dynamos, and the construction work has been placed in the Brush Company's hands. There are at present two Manchester machines driven by Fowler engines, and two more Manchester machines and two Globe engines are on their way out, making four in all. The switchboard which is being constructed by the Brush Company will carry a number of four-way double-pole switches, enabling any circuit to be connected to any dynamo ; there are 33 lamp circuits in all, and mains are brought from each floor direct to the engine room ; the largest circuit has about 60 lamps on it. The measuring instruments are Brush-Nalder gravity pattern, and the cut-outs are ordinary lead fuses on porcelain bases. The fittings, which are mostly wall brackets and electroliers in groups of three, five, and six lights, are all made in the colony.

The Brush Company have a very fine show window at their premises in Margaret Street, and the display of Mordey transformers, Victoria dynamos, voltmeters, ammeters, reading lamps, wall brackets, ornamental glass ware, switches, &c., cause many a passer-by to stop and make admiring comments and remarks on the wonders of electricity. Inside one finds a large stock of the various appliances displayed in the window, and of material too large to go in the window, such as a number of the Brush vertical high-speed engines in various sizes, and a handsome looking 25-unit Mordey alternator. This same alternator, by-the-bye, is going a journey, shortly, to Medlow, in the Blue Mountains, where an enterprising gentleman owning a large estate is erecting houses and cottages, and as he builds instals electric light in each habitation. There is at present a small continuous current plant there, but as the buildings increase, the distance they are away

from the supply station also increases, and as the estate extends from two to three miles on each side, the enterprising proprietor has been "converted" to the high tension alternating current system. As there is no gas obtainable near, there is a universal demand for the electric light, and even the local railway station and post office are going for the popular illuminant.

Messrs. H. H. Kingsbury & Co. are busy over the lighting of the Clyde siding and Darling Harbour for the Railway Department, and numerous smaller contracts, and have recently increased their business premises by the addition of a foundry and blacksmith's shop, besides adding considerably to their workshop machinery. I hear that a night or two after the "Australia Hotel" Company took over their electric lighting plant from Messrs. Kingsbury, the enginner appointed by the hotel managed to burn out an armature of one of the fine large Manchester dynamos.

One of the electric lighting Bills came up for its second reading last week, and, as was expected, met with strong opposition, especially by the labour candidates, who were all strongly in favour of the Municipal Council taking up the question. The discussion was adjourned.

POLYPHASED ALTERNATE CURRENTS.

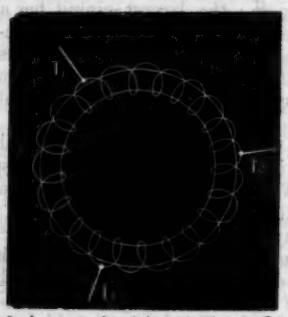
(Continued from page 534.)

V.—MOTORS.

THE chief interest attached to polyphased alternate currents lies in the production of motive power. Although with these currents it is possible to obtain motors that are either *synchronous* or *asynchronous*, they are used chiefly as asynchronic motors, and we shall in this article only discuss motors of this kind.

An asynchronic motor, worked by polyphased currents, is characterised by two essential parts: an armature and an inductor moving relatively to one another. The inductor is connected directly with the source of electricity, dynamo or transformer, and the armature constitutes a circuit closed electrically upon itself, and not connected electrically with the inductor. The relative positions of these two parts differ according to the power of the motors. In motors of low power, the inductor is fixed and the armature is movable; in high power motors, on the contrary, the armature is fixed and the inductor is movable. We may here remark that with polyphased currents a great confusion of terms still prevails with regard to the name to be given to the two essential parts of the motor. For our part, we keep to the expressions used to describe continuous current motors, and apply the name of *inductor* to that part of the electrical circuit producing the field, and that of *armature* to that part that moves in the field and so becomes the seat of induced currents.

Low power motors.—In low power motors, as we have just said, the inductors are fixed and the armature is movable. This inductor consists of a series of bobbins,

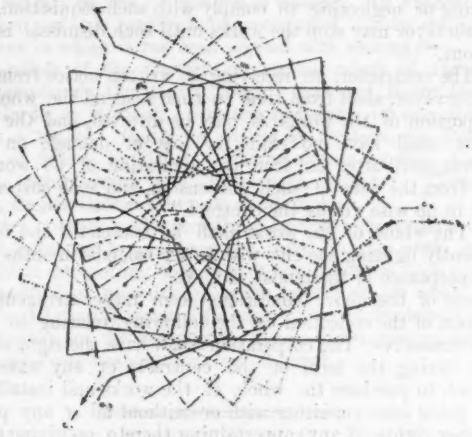


Gramme ring producing a rotating field with triphased alternate currents.

FIG. 1.

or to speak more generally, of windings traversed by triphased alternate currents. These currents develop in the interior of the cylindrical space left by the winding a revolving magnetic field. If the winding is simple or bipolar, we get a single magnetic field, the angular speed of which corresponds to one revolution per period. If the winding is combined to produce four, six, or eight poles, the angular speed of rotation of the field is only half, a third, or a quarter of a revolution per period. The frequency or number of periods varies at present between 30 and 40 per second.

This revolving field may be realised theoretically by more or less complex windings. One of the simplest methods of realisation is to take a Gramme ring wound round, but without a collector (fig. 1). By attaching three points of the winding 120° apart to a triphased alternator, we get in the interior of this ring a revolving magnetic field; the three elementary bobbins constituted by the three-thirds of the ring are then coupled by the triangle method. But more often, and this is how Mr. Brown's motors are constructed,

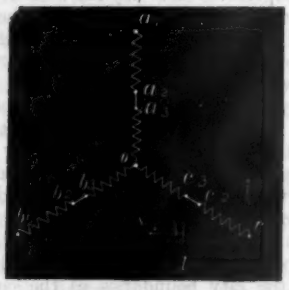


Winding of Brown's 15 kilowatt triphased alternate current motor.

FIG. 2.

the drum winding is used, the copper strands forming this winding being connected together by connectors arranged round the periphery, and leaving the cylindrical space in which the armature is placed perfectly free and accessible.

As regards the constancy of the revolving magnetic field produced by a winding constituted in this way, it is difficult to say how far we can depend upon it, on account of the hysteresis, the reactions of the armature, and the more or less sinusoidal form of the current passing through the three bobbins. We can demonstrate, however, and we recommend young students of electricity to go over the trigonometrical calculations, which are very simple, of this demonstration, that, in the case of three similar bobbins, lagging by a third of a period, traversed by equal sinusoidal alternate currents, also lagging by a third of a period, placed in a homogeneous medium of constant magnetic permeability, the magnetic field is constant. The same may be said, and has often



Connections of the six windings in the inductor of Brown's 15 kilowatt motor.

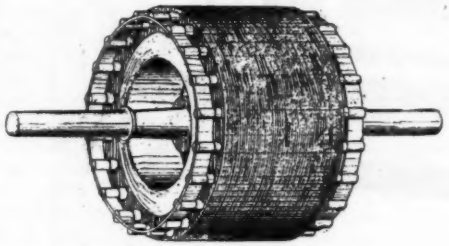
FIG. 3.

been proved, in the case of two alternate sinusoidal currents lagging by a quarter of a period, passing through two bobbins placed at right angles.

We may also quote as a type of inductive winding that of the motor of 15 kilowatts, the description of which appeared in the ELECTRICAL REVIEW for the 16th of October, 1891, page 448. We will, however, add a few supplementary remarks in order that this description may be fully understood. The motor as it is actually constructed is provided

with 90 bars, whereas the theoretical winding represented in the figure accompanying the description (fig. 2) only shows 54, or 18 for each of the three bobbins. These three bobbins are besides divided into two halves connected in tension, as shown in the diagram (fig. 3.) By this mode of coupling the 9 free ends of wire are reduced to three, which communicate directly with the triphased generator. In order to reverse the direction of the rotation of the field, it is sufficient to reverse the current in two of the three windings; we thus change the direction of rotation of the field, and, consequently, that of the motor; this is very easily effected by means of a reversing commutator.

The armature consists, in small motors, of a series of longitudinal bars parallel to the axis, and connected in derivation. A revolving field motor could be realised by placing in the space formed by the inductors a Ferraris copper cylinder or one of solid iron, but as the revolving field is not homogeneous, the Foucault (eddy) currents developed in these masses of copper or of iron would not be directed so as to produce a very appreciable motive couple, and thus the efficiency and specific power of the motor would be reduced. In order to obtain high efficiency and high specific power, we must modify the armature and construct it as shown in fig. 4. A



Armature of the Brown 15 kilowatt motor.
FIG. 4.

cylinder formed of discs of thin sheet iron insulated electrically, is pierced in its periphery with holes parallel to the axis, in which are inserted bars of copper, also insulated, the extremities of which, on each side of the cylinder, are soldered into two rings of copper, and form a winding in derivation. The iron discs serve to reinforce the magnetic field, without producing in it any Foucault currents; the induced currents are generated in the bars of copper and are thus developed in the direction corresponding to the maximum *torque* between the revolving magnetic field and the induced wires.

The theory of the motor so constituted does not differ essentially from the one we gave, a few months ago, when describing Messrs. Hutin and Leblanc's revolving field motor, and we refer the reader to this article for the explanation of the final formulæ. These formulæ show that the angular speed of the motor when turning freely tends to be equal that of the revolving field, the induced circuit then remaining motionless with regard to the field. When the charge is increased the speed is diminished, but remains very little different to that of the field, if the electrical resistance of the induced circuit and its self induction are themselves very small. On account of the low relative speed of the field and the armature, each of the wires constituting the winding is the seat of a periodic electromotive force of low frequency, the period of which, when turning freely, may last several seconds, and which, when fully charged, generally remains less than one period per second. As the different wires constituting the winding lag in the magnetic field, and, when the permanent rate of working is established, are the seat of alternate currents of the same period, it follows that the motive torque produced by the sum of the torques exercised by each wire remains constant, and that the motor turns with an angular speed as uniform as that of continuous current motor bearing elementary bobbins equal in number to the induced wires.

Owing to the low resistance of these induced wires and to their feeble *impedance*, on account of the low frequency realised, the induced currents are of great intensity and produce a powerful *torque*, both at starting and when working normally. This powerful *torque*, at starting, constitutes an important and interesting characteristic of revolving field motors, whatever may be the method adopted for producing this revolving field. But the employment of polyphased alternate currents has another advantage, of no less importance, especially for motors of low power. From the very fact that the inductive system is connected with the three wires coming from the transformer or the generator without any other break than the interrupter, and that the armature forms a distinct circuit, absolutely closed upon itself, the motor requires no commutator, no rubber, no sliding contact, and its maintenance is reduced to simply filling the oil cups of the two bearings which support its axle. It is difficult to conceive an apparatus that would be more simple, less likely to get out of order, or better suited to the distribution of electrical energy when it is required to feed motors of low power. The only inconvenience attached to the employment of these motors is the third wire, but this would not prove a serious drawback in the case of fixed installations, considering that with continuous currents distributions are carried on requiring three, and even five wires.

High Power Motors. — We have already said that for motors of great power, and the only type that we can mention as having entered into the domain of industry, is the 100 horse-power type constructed by M. Dolivo-Dobrowolsky, the respective positions of the armature and the inductor are changed; the inductor receiving the current from the dynamo or transformer is movable, whereas the armature closed upon itself is fixed. This arrangement tends naturally to complicate the construction, since the current has to be brought to the movable inductor by brushes and collecting rings. This is the reason for this construction. We have stated and proved that the inductor is traversed by currents of high relative frequency, whereas the armature, on the contrary, is the seat of currents of very low frequency. It follows that the inductor is subjected to very frequent reversals of magnetisation, whilst the armature describes a much smaller number of magnetic cycles in the same time. From the point of view of losses by hysteresis, therefore, it is better to give the smallest possible mass to the system subjected to frequent magnetic reversals, and without importance to have large magnetic masses in those parts of the motor that are subjected but rarely to reversals of magnetisation. These conditions are obtained in motors of great power by putting the inductor inside and the armature outside. The losses from hysteresis are thus reduced to a minimum. In motors of low power the efficiency is a secondary consideration, and is to a certain extent sacrificed to simplicity by leaving the inductor movable, which does away with brushes and collecting rings. Fig. 5 shows the outward appearance of M. Dolivo-Dobrowolsky's 100 *nominal* horse-power motor, which worked the artificial cascade at the Frankfort Exhibition. We find here a movable inductor receiving the current through six collecting rings, although this number will be reduced to three in practice. As constructed at present the six rings communicate with the six free ends of the three winding, and thus enable the three bobbins, or to speak more correctly, the three windings to be connected either in a triangle or a star, as required, so that we can determine by experiment which coupling is most favorable to the good working of the motor under the different conditions of its practical employment. This winding is multipolar and produces on the periphery of the inductor four revolving poles instead of two, so that when working normally freely the angular speed is only about half the frequency of the generator or transformer. If, for instance, the frequency of the alternating current is 20 cycles or periods per second, which corresponds to 1,200 periods per minute, the angular speed of the motor will remain always less than 600 revolutions per minute, this speed of 600 revolutions per minute being moreover the maximum limit compatible with free working. Thus the revolving field motors can never run too fast, which is a great advantage in certain applications.

When reduced to its absolutely essential elements, the triphased current motor of M. Dolivo-Dobrowolsky consists of two concentric rings of soft iron, the outer ring acting as a fixed armature, and the inner as a movable inductor. The two rings are pierced with holes parallel to the axis, very near to the periphery, in which are inserted the inductive and induced conductors, the connections between the conductors being made by means of connectors arranged respectively on the surfaces of both parts.

The conductors forming the inductor are coupled together so as to produce a revolving magnetic field with four poles, the fixed induced conductors are also coupled together in three circuits in a star, and so arranged that a resistance can be introduced into them at the moment of starting, a precaution which seems only necessary for motors in which the power exceeds 15 kilowatts, for Mr. Brown's motor, which

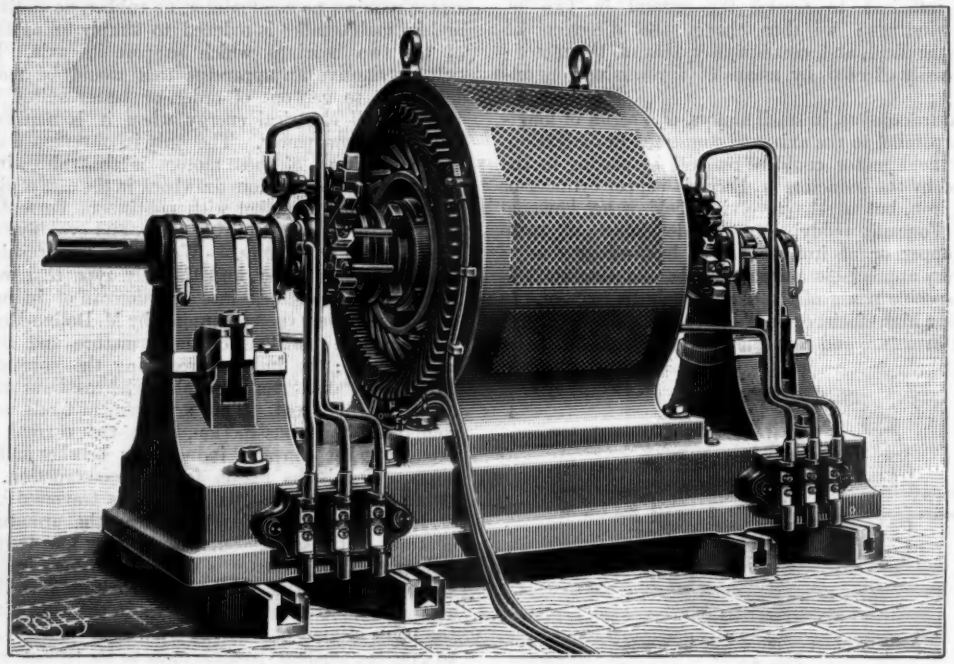
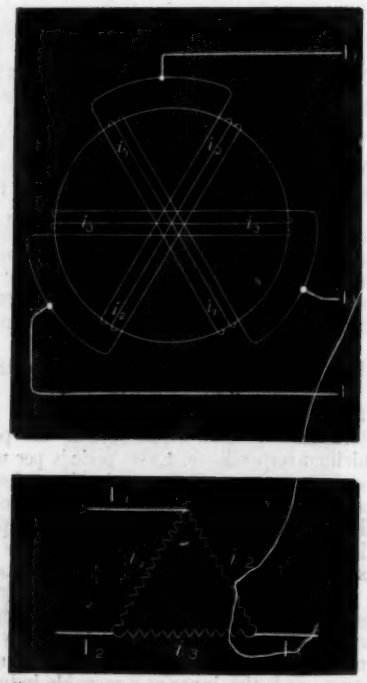


FIG. 5.—M. DOLIVO-DOBROWOLSKY'S 900 N.H.P. TRIPHASED ALTERNATE CURRENT MOTOR.

was described in the ELECTRICAL REVIEW of October 16th, 1891, is not provided with this arrangement, which, in our opinion, complicates the construction of the armature without affording any great advantage.



Star coupling of three bobbins for the production of a rotating field.

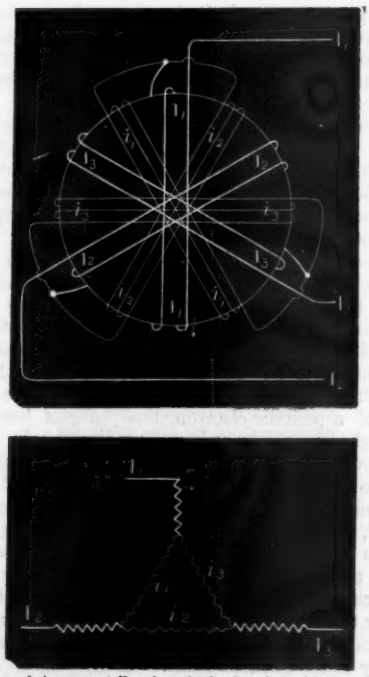
FIG. 6.

We shall have occasion to refer again to the details of winding and construction of this motor when the Experimenting Committee of the Frankfort Exhibition publish their report, these details being as yet to a certain extent shrouded in mystery.

Different Modes of Coupling for the Production of a Revolving Magnetic Field.

We have supposed up to now that the three elementary bobbins producing a magnetic field were connected in a star.

In a paper sent by M. Dolivo-Dobrowolsky to the International Congress of Electricians at Frankfort, the writer indicates two other arrangements for the same purpose, which are shown in diagrams 6 and 7. The first (fig. 6), which can be understood at a glance from the diagram, is simply the connection of the three bobbins in a triangle. We can see that, by this



Production of *six* currents lagging of $\frac{1}{6}$th of period with *three* currents lagging of a $\frac{1}{3}$rd (Dolivo-Dobrowolsky coupling).

FIG. 7.

arrangement, the intensities, i_1, i_2, i_3, of the currents passing through the three bobbins lag 60° behind those passing into the conductors, I_1, I_2, I_3. The coupling shown in the diagram (fig. 7) comprises six bobbins, and, in accordance with the remark we have just made, gives, by means of three currents lagging by a third of a period, six currents lagging one behind the other by a sixth of a period. By arranging suitable proportions between the number of spirals and the thicknesses of the wire on the two series of bobbins, I_1, I_2, I_3, on the one hand, and i_1, i_2, i_3, on the other hand, we obtain six equal magneto-motive forces lagging by a sixth of a period, which combine to produce a constant revolving magnetic field. But as it is easy to show that three currents, or even two, only, are sufficient to produce a constant revolving magnetic field, the complex arrangement indicated by M. Dobrowolsky seems to us, as far as we understand at present, needlessly to complicate the winding of the inductive circuit without any important advantage being gained by it.

In short, if for motors of great power, and for considerations relating to the frequency of the magnetic cycles to which the armature and the inductor are subjected, it is expedient to place in the centre of the inductor, or the part which receives the current, with a view to reducing its volume as much as possible, three collecting rings will be sufficient in any case to convey the current instead of six, and a simpler winding can be used in a star or a triangle to ensure the constancy of the magnetic field. We can also place the inductor inside without making it turn, and thus the collecting rings can be entirely dispensed with. Instead of variable resistances being introduced into the induced circuit at the moment of starting, they would be introduced into the inductive circuit, which would enable the revolving induced circuit to be left closed upon itself as in Mr. Brown's 15-kilowatt motor. Notwithstanding their simplicity, the triphased alternate current motors of great power are still capable of being improved and simplified, combining the requirements of theory with the necessities of practice, and thus extending the applications for which it can be employed.

Applications of Triphased Motors.

When we consider the facility with which the triphased current motors are started, and the ease with which these currents are transformed, we can foresee that they will be applied successfully to the transport of great motive power to long distances, notwithstanding the obvious inconvenience of employing three wires instead of the two required for continuous currents and ordinary alternate currents.

The possibility of localising the dangers of the high tensions in the line and the transformers, and of thus rendering the generators and receivers absolutely harmless, are sufficient to justify this preference, not to mention the facilities for sub-dividing the mechanical power afforded by the system of distribution by triphased currents. Transports of motive power into mines, where fire-damp is so dangerous, can also be easily effected by means of polyphased motors, as they have no friction contact, and no part likely to give off sparks. Sparks will only be produced at the interrupter when the system is started and when it is stopped, but it will always be possible to protect this part and render the sparks absolutely harmless. Also, for the railway system proposed by M. Heilmann about a year ago, of which we shall have occasion to speak when the experimenting apparatus now in course of construction are finished and tested, the triphased alternate current motor without collectors or brushes constitutes an almost ideal method of transmitting motive power between the fixed machine placed on the locomotive and the axles to which it imparts the rotatory movement, since these motors suppress by their very construction all friction contacts, and consequently all maintenance of the non-accessible parts. Lastly, in installations worked by motors that are not easy of access, and which cannot therefore receive frequent attention—certain ventilators of large buildings, for instance—it will be advantageous to employ polyphased motors, which will only require to be visited periodically, in order that the oil-cups may be filled up. It might even be expedient in this case to use a distribution of electrical energy by continuous currents, and to transform part of them into polyphased currents. We are thus led, naturally, to the study of the apparatus by means of which this transformation, or the reverse, can be effected. This will form the subject of our next article.

E. H.

PRICES AND CONDITIONS FOR THE SUPPLY OF ELECTRIC CURRENT AT MONACO.

[FROM OUR OWN CORRESPONDENT.]

Section 1. The company supplies current in every street in which leads have been laid down, to every consumer who enters into an agreement for at least five years and guarantees a minimum consumption for each lamp.

Section 2. The current is conveyed to the consumer from the nearest lead by means of a branch. The installation of this branch as well as all works and materials supplied from the initial point of the branch, as well as the entire interior fittings, are defrayed by the consumer. All other work and supply of material from the meter inwards may be executed by any contractor at the pleasure of the consumer. If the consumer prefers to entrust the company with their execution, their price will be arranged jointly. In no case can the company be responsible for the apparatus, whether installed by itself or by some other party.

The company may refuse to supply current to any consumer if his installation is found defective, whether initially or by reason of alterations.

Section 3. The current is supplied either according to an estimate or per meter. In the latter case the consumer must cause to be set up, at his own expense, one meter or more, of a system approved by the company.

The meter or meters must be adequate to the maximum electrical consumption of the subscriber. The meter is to be tested for its accuracy and regularity by any method which the company thinks suitable. If the meter comes to a stoppage the consumption for the 10 previous days serves as a basis for the estimation of the consumption. The subscriber is expressly prohibited from undertaking any alteration in the arrangements of the meter, of its appendages, and in its position.

The subscriber must at the demand of the company supply a suitable place for the meter and the transformers, and must allow the representatives of the company free access to inspect it *in situ*. Every refusal will involve legal proceedings. The places for meters must be readily accessible and be so situate that the figures of consumption can be accurately noted down.

Section 4. The company is bound, if requested, to supply each consumer with a meter on hire.

The monthly rent for a meter is shown in the following table, and is due along with the payment for current supplied.

500 watt...	2½	francs
1,000 „	4	„
2,000 „	5	„
4,000 „	6	„
10,000 „	10	„

The rent above 10,000-watts is fixed by special agreement.

In return for this rent the company undertake the erection, maintenance, and repairs of the meter.

Section 5. The subscriber has full control over the current which passes through the meter. He may light up or extinguish each of the arc lamps or a portion of them.

The subscriber may not, without previously informing the company, undertake any alteration in the interior arrangement of his installation, and he may not commence such alterations until he receives an acknowledgment of the receipt of his notice of alterations. In case of departure from this stipulation the company is at liberty to cease the supply of current without prejudice to a claim for damages.

(This clause clashes with the first clause of section 5.)

Subscriptions are of two kinds:—Subscriptions for the entire year and for the winter season.

Section 7. (?) The subscription by estimate is understood to be from night-fall to midnight.

Prices as follows:—

	For the year.	For the season.
10 candle lamp,	8 fr. per month ...	10½ fr. per month.
16 „ „	12 „ „ ...	15¾ „ „

For lamps of greater intensity the charge is in proportion.

Section 8. Subscription as per meter:—10 candle-lamp, hourly, 60 centimes; 16 do., 95 do. For lamps of higher intensity in proportion.

Average consumption guaranteed by subscriber :—For the season, 9 francs monthly per 10 candle-lamp ; do., 13 francs for 16 do.

For the year :—6 francs for 10 candle-lamp ; 9 francs for 16 do., monthly.

The number of hours burning is deduced from the indications of the meter and the hourly consumption of each type of lamp.

For lamps of higher intensity the price will be calculated from the scale for the 16 candle-lamp.

Section 9. The above prices include the supply of glow lamps, but the company is only bound to replace such as are out of working order in consequence of the passage of the current. Every lamp broken or damaged from any other cause is to be replaced at the cost of the subscriber at the price of five francs for a 10 or 16 candle-lamp.

The following sum is payable in advance as a guarantee, six francs per 10 candle-lanp, and nine francs per 16 candle-lamp. On the expiry of the subscription this sum is deducted from the amount due to the company.

The payment for current supplied is entered in presence of the subscriber in a small book which remains in the custody of the subscriber. If the account is not paid within five days from presentation of invoice, the company will cease the supply of current, reserving its right to sue for the arrears.

The subscriber renounces his claim for a return of any sum paid in excess.

Section 10. In case any accident compels the company to interrupt the supply of current temporarily, it is liable to no other compensation than to refund any sum paid in advance for current which has not been furnished.

Section 11. The subscriber cannot put the current to any use save that specified in his subscription policy. He is not allowed to hand over to any third party a part or the whole of the current supplied him.

Section 12. Subscribers must allow at all times the officials of the company free access to the localities where the motors and transformers are set up.

Section 13. The company reserves the right of not burdening the leads between 9 a.m. and 3 p.m., for the sake of repairs, &c.

Section 14. The cost of drawing up and stamping the above policy are to be defrayed by the consumer.

ON THE TELEPHONING OF GREAT CITIES

WE bring to a close to-day the correspondence on the telephoning of great cities. The opportunity may fitly be taken to review the correspondence; to observe its bearing on our criticism ; to consider whether any new evidence or new argument has been brought forward to justify a reversal of, or any modification in, the conclusions we expressed ; and to add further evidence on those of our statements which have been questioned.

We may reasonably assume that there are some of our readers who are interested in the subject without having a knowledge of all its minutiæ. From the correspondence they must have formed the impression that it is one of considerable difficulty. So it is. But there is not so much difficulty in arriving at an understanding of the questions at issue, as our correspondents' letters would imply. In reviewing them we shall endeavour to avoid the continuance of a mystification which is quite unnecessary.

It will be remembered that we divided Mr. Bennett's plans into two main features—numerous exchanges and the Mann system—considered their merits and demerits for themselves, and questioned some of the advantages which were claimed for them in their important details. A great part of the confusion which, it must be admitted, has resulted from the correspondence, has arisen from the neglect to follow our example in selecting main issues and important details. Not that we wish to imply that the subject is one in which details can be neglected ; on the contrary, they are of the utmost importance ; but, if the main features are not good in themselves, they cannot be made good by the ability to combine with them some advantages of detail. No such advantage has, however, been suggested in this correspondence which is not open to argument, and possibly to proof, as a disadvantage, and they must be proved in themselves before they can be thrown in the balance as makeweights for something else.

The first of our main contentions, that experience had shown the advantages of concentration as against subdivision has not been contested, but one correspondent, whilst endorsing our view generally, holds that the projected sub-division was necessary if provision were to be made for the future great extension in the use of the telephone, considering the present limitation of exchanges to 10,000. The point is important and we gave attention to it, alluding to the unwisdom of taking—as our correspondent also does—present limits for the exchanges and permitting speculations into a distant future for the subscribers.

It is the second point—the Mann system—which has, throughout the correspondence, occupied the principal attention. It will be generally considered satisfactory that the correspondence has not closed without Mr. Mann having his "little say," as he modestly calls an able letter which we publish to-day.

We described the Mann system as being one by which the subscribers notify their call to the operator by word of mouth instead of by visual signal. We said the system was better known as the Law system and we described "the difference between the Law circuit wire as originally used, and that known as the Mann circuit wire," the first being "a continuous line" and the second "a main line with branches." The remark of one of our correspondents, "the oft-repeated and annoying request to subscribers 'one at a time, please, one at a time,'" would apply to any call wire system. It was as a circuit wire system without regard to the nature of the circuit wire that we considered the proposals made, and had the discussion been continued on the same lines, very much time and space would have been saved, and many misunderstandings prevented, though the advocates of the Mann system might perhaps have still remained under the impression that the Mann system and the Law system differed in something more than name.

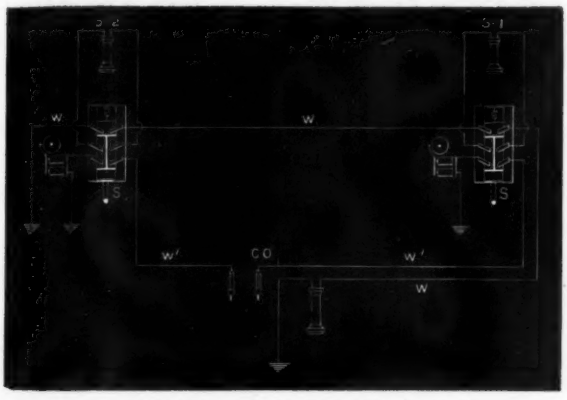
The distinction we drew has been vaguely questioned, but no corrections have been made to it in response to our request.

Investigation shows that there is much misconception on the subject. It is desirable that we should first quote the published authorities. "The Telephone" (Preece and Maier), says (p. 299), "The characteristic part of this [Law] system consists in the employment of a special wire . . . which . . . after having passed through the apparatus placed in the network returns to the central office telephone, where an operator is always listening." Of the Mann system it says, "The calling wire . . . . starts from the exchange [and] terminates abruptly at any convenient point. . . . Into each subscriber's office . . . a branch or spur is taken . . ." We would first call attention to the fact that mention is made of the call-wire returning to the central office and being connected to the telephone, but Mr. Poole in "The Practical Telephone Handbook," which we reviewed last week, goes further. He says : "In the Law system the subscribers were joined to the call-wire in series, *no earth being employed*, whilst by the Mann system the subscribers are joined in derived circuit to earth when they turn over their switches." No doubt this represents a very prevalent belief. Probably the Law system which was introduced into England consisted of a return loop without earth. Our correspondents have supposed that the return loop without earth was the only Law system. Our correspondents are mistaken.

There are two early British specifications relating to the Law system, Nos. 5,319 of 1879 and 4,165 of 1881. Both were provisionals only. The second mentions the Law system as being described in a United States specification.

We give below a simplified diagram of fig. 3, from that specification forming part of U.S. letters patent, No. 220,874, dated October 21st, 1879, for which application was filed August 11th, 1879, and granted to Frank Shaw, of New York, assignor to the Law Telegraph Company, of same place. The inventor says, "From each subscriber's station I run two wires to a common central office, one of which I preferably run to no other station or stations, although several stations may be located thereon ; and the other wire I run to as many other subscriber's stations as the amount of business done by them warrants. The first is the private and the last is the call

or signal wire. . . . At the office end of the signal wire I place a receiving operator, who sits with the receiving instrument or telephone constantly at or near his ear, ready to receive the name or number of any subscriber desiring to communicate, and of the correspondent with whom he desires to be placed in communication. . . . In fig. 3 stations Nos. 1 and 2 represent the instruments in two subscribers' stations. . . . . S S are switch devices for connecting the instruments at will with either the call or signal wires, or with the private wires. . . . W is a call or signal wire and w^1 the private wires." It will be noted that the specification mentions the "office end" of the signal wire and that the



C O, Central office; s^1, Station No. 1; s^2, Station No. 2.

drawing shows both ends to be earthed. There is no complete metallic circuit here; but we have other evidence that complete metallic circuits were used. In a patent (No. 251,234) for a switch, applied for by Joseph O. Jeffries on September 25th, 1880, and granted December 20th, 1881, after a description of the two-wire system, in which one wire is for use between subscribers, and the other is used for calling, we find the following:—

"The calling wire is either a metallic circuit looped into each subscriber's station, or *a single main line with branch wires* running from it to each subscriber, the distant end of the main line and the end of the branch in each subscriber's office being left open. . . . If a simple branch from the calling wire is used instead of a loop . . . one of the springs should be connected with the ground."

Mr. Mann says that the Law system necessitated a special instrument, which would not actuate his system; but this seems to have been a special instrument which would actuate either. It cannot be one which would need to be set aside for the handiwork of a local brass finisher, because it bears a striking resemblance to one which we find described in the "Practical Telephone Handbook," as very neat and reliable.

As this refers to systems in general use at September 25th, 1880, and Mr. Mann says his system was invented in the spring of 1882, there would seem to be no need to continue any discussion on the question whether the Mann call wire was or was not in use before it was invented by Mr. Mann. Nor need any less credit be given to Mr. Mann because he shares the honour with someone else, whose name has not been handed down.

We have evidence then that in 1880 three kinds of call-wire were known—the earthed line with stations in series; the metallic loop with stations in series; and the main line with stations on branches. But these different types had not different names; they were content with the name of the original Law system; and so it probably happened that when India was prepared to import the Law system the form of call-wire in vogue was the main line with branches.

Mr. Mann, following the precedent of several correspondents in a disinclination to accept a statement of fact, considers it simply impossible that Mr. Goodwin can have found this branch wire system working in India in 1883, because Mr. Mann thinks it only became known outside Dundee in 1885. This assumption that telephonic regeneration is only to be attained *viâ* Dundee, is at the root of much of the unsatisfactory element which has lately appeared in our correspondence columns. Mr. Goodwin gave the result of his experience and in that way set an example to many other correspondents of what is required in such a discussion. Mr. Mann's remarks about Mr. Goodwin are therefore entirely reversed. It ought to have occurred to Mr. Mann and others, on reading Mr. Goodwin's letter, that it might have been possible for the system to get to India without going through Dundee.

We said that numbers of exchanges had been fitted with the circuit wire system and had abandoned it. This statement our correspondents have met with a very emphatic agreement as regards the Law, and an equally emphatic disagreement as regards the Mann. Our correspondents' conception of the Law circuit wire being a metallic loop, the view they hold is that the abandonment of Law exchanges has been due to the use of the metallic loop, and that as no exchanges outside England have been called Mann exchanges, no exchange has been abandoned which was fitted with a main circuit wire having branches. That such an inference is an entirely mistaken one, is now obvious.

With the diagram before us, it is not difficult to see the growth of the branches from an earthed main line, and the "joining the ends of two of the circuit lines," as Mr. Mann expresses it, so that in the event of a break there are two paths to the central office, and we throw out the suggestion that in the description quoted from the "Telephone," the return to the office may be meant for a return to an earthed line and not to a metallic loop. As favouring this view we may remark that no earths are shown in the diagram, even for the direct wires.

The details of principal importance which have been referred to as adding to the value of the circuit system are, first cost of apparatus, space occupied, and rapidity of operation.

In considering the first cost of apparatus it has not occurred to any correspondent to point out that in the paper the comparison of first cost is, on the one side, the cost per subscriber in an exchange of 5,000. On the other side the wording is not quite clear, but it would appear to be the cost per subscriber on the then number connected to the Mutual exchange at Manchester. The calculation at the end of the paper gives these as 506. As will be apparent from the correspondence the principle generally adopted in large exchanges is to multiply the points of access to a line, so as to enable connections to be made at numerous places proportionate to the size of the exchange and the number of operators engaged. It follows that a comparison of a 5,000 basis in the one case, and a 500 basis in the other, is no comparison at all. An exchange of 5,000, on the one hand, should have been compared with 10 exchanges of 500 each on the other hand. The first cost would be less in the latter case for any system, but the comparison should not stop there. It should be carried on to the comparative expense and facility of operating one exchange of 5,000 and 10 intercommunicating exchanges of 500 each, and the further consideration of whether the greater cost gives the greater advantages, and if so whether they are worth it.

Much has also been said about the saving of expense incurred by the omission of indicators and other parts not used in the circuit wire system. It was said in the paper that "with the Mutual system vanishes the whole costly and complicated paraphernalia of American switch-room apparatus." The fact is that the parts dispensed with are those which bear a fixed rate per subscriber. They are not subject to multiplication like the contact points, and the proportion which they bear to the whole is less in a large exchange than in a small one. The comparison should have been the cost per subscriber of the signal apparatus and the cost per subscriber of the circuit wire, and we think the difference would be very much less than our correspondents imply. A saving of expense is obtained by the use of horizontal switchboards because they are approachable from two sides, and, as the length is determined mainly by the space required for operators, it follows that a board which has two working sides need be only half the length of a board which has only one working side, and if it is only half the length it need have only one half the points of contacts to the lines. It is for the last-mentioned reason that it costs less. Horizontal boards may be used with either system, but they are more suited to a circuit wire, than to a signal, system, and they have been adopted in many Law exchanges. The advantage claimed by the use of a horizontal switchboard is essentially one of those which can be admitted only after it has

been thoroughly considered in itself. With an undoubted advantage in less cost, it is open to the consideration of disadvantages in working and otherwise.

The question of space occupied has proved the greatest stumbling block. It is not difficult to show how unnecessary all the square inch calculations are. The comparison made in the paper is of little practical importance, but it is noticeable for the very great difference of space stated to be occupied by the apparatus required for the respective systems—5¼ square inches per 100 subscribers on the circuit wire system and 9·9 square feet on the other. The fact is that 5¼ square inches does not represent the space required for 100 subscribers. It represents merely the size of a block of 100 contact points, and it has its counterpart of the same size on the other system. It might be supposed that the parts dispensed with occupy a space equal to the difference between 5¼ sq. in. and 9·9 sq. ft. but it is not so. The error has probably arisen from comparing the size of a 100-contact block with the ultimate capacity which includes a number of those blocks, the space occupied by the indicators being added to the ultimate capacity. On any system the length of switchboard frontage must provide room enough for the operators. Before the contacts occupying a space of 5¼ square inches could be used by the number of operators required to attend to them, they would need to be spread out to about the same length as the other comparison.

We alluded to a drawback in disconnections through several exchanges on the call-wire system, which has been questioned. It may be briefly explained by stating that on the circuit system each exchange represents a break of continuity which has to be bridged by verbal message, with its liability to error and delay, whilst on the signal system there is no break and there is an immediate and automatic notification to each operator by a signal from either subscriber. One of our correspondents remarked that there is at times some uncertainty in this signal, because subscribers occasionally ring without intending to be disconnected, and another correspondent showed that this uncertainty may also be prevented. This was followed by a rejoinder, that the prevention involves the use of batteries, which has an objection. It has first to be decided that it is desirable to adopt such a system. If it is desirable, it can be done with magnetos as well as batteries.

The correspondence has not added any definite information to that previously given on the question of rapidity in operating. In the paper it was stated that there was, "roughly speaking, about three times the work with the American than with the Mutual system," the statement being based on comparative figures which we previously showed to be erroneous. These figures applied to movements. Mr. Mann takes a similar comparison for time. It would be easier to show the comparison to be wrong in time. Another correspondent refers to the fewer and less arduous "movements," disregarding our reminder that something more than "movements" have to be considered. The best evidence for the quickness of the call-wire system is from Mr. Goodwin, who says, "The 'call-wire system' I admit is the most rapid for small exchanges," and we believe it is generally understood that under favourable circumstances the service is quicker by the call-wire system; but experience in most things shows that it is unwise to rely on the prevalence of favourable circumstances, and Mr. Goodwin's testimonial to quickness was followed by a "but." How much quicker it may be we cannot gather, and we despair of arriving at any basis of comparison which should be decisive in the details, but as the number of subscribers per operator is determined by the ability to give a prompt service at the busiest hours, the broad question may be reasonably settled by the number of subscribers attended to by one operator. The author allowed for 60 to 100 subscribers per operator on his system. One of our correspondents states from experience that this is too many even in a comparatively small exchange, another replies that it is too many in that case, because of the switching apparatus employed; a third and fourth show that in other exchanges it is not too many. There are large exchanges using the Law system, which we think would show that the numbers given are not unreasonable. There is apparently no dispute that on the other system the number is seldom, if ever, less than 66 and is sometimes 100. Where then is the superiority? And with these facts capable of accurate proof, there would seem to be little advantage in continuing endless arguments on details that prove nothing.

For going through two or three switch-rooms the whole of the operations at the subscriber's exchange were doubled or trebled. We previously stated that this was not the practice. In *Harper's Weekly*, October 3rd, appeared an able description of "The Telephone in New York," by Herbert Laws Webb. From it we extract the following:—

> All the exchanges are connected directly together by underground cables which are used exclusively for trunk wires. The trunk wires between the exchanges are divided into sending and receiving circuits, each circuit being used only for connections in one direction. The receiving trunks at the exchange terminate not in spring-jacks, but in cords and plugs. These cords and plugs are in front of a section of the multiple board known as the "trunking section," and all the connections are made by boys, who receive their orders directly from the operators at the other exchanges. Each boy has a head telephone to which a pair of wires runs from the distant exchange, the circuit being there connected to contacts accessible to every operator. This arrangement is termed a "calling circuit." The operator who needs a trunk connection at another exchange plugs on to the calling circuit, and speaks her orders directly into the boy's ear. She calls for "1,650 Spring, on trunk 305," and the boy picks up the plug corresponding to trunk 305, and plugs it into the spring-jack number 1,650 in the section of the multiple board in front of him. The sending trunks at each exchange, which of course become the receiving trunks in the other exchange where they terminate, are distributed among the different sections of the board, so that each operator may have trunk wires available for connecting her subscribers through to those of other exchanges. This systematic arrangement of trunk wires, a sort of double-track system with special circuits by which to order up connections, is a highly important part of the system, as a large proportion of the traffic is between subscribers belonging to different exchanges.

This is a description of an American exchange taken from an American contemporary. We believe that practically the same system is in use in London, and has been for years, though it cannot be said to have been copied "blindly" or otherwise. When we mentioned this method of communication between exchanges, we were asked—if the service wire is of advantage between exchanges why not to subscribers too? To sustain the accuracy of our criticism it is not necessary for us to answer that question. In the absence of the proofs to the contrary, for which we have been vainly waiting, we shall assume that it has been retained for the purposes for which it has been found suitable, and discarded for the purposes for which it has been found unsuitable.

The whole basis of Mr. Mann's letter is so materially affected by the information we have given above, that we need give but little attention to his arguments. He remarks that the answer to our question, why the circuit wire system had not been more generally adopted, is easy. Very much more difficult questions might be more easily answered by accepting, without proof, such reasons as he gives. Mr. Mann believes, and would have us believe, that every telephonic engineer everywhere has some "axe to grind"—except the few who advocate the circuit wire system. Such reasoning needs no serious attention.

Whilst we have been unwillingly compelled to emphasize the accuracy of our criticism, we may draw attention to the fact that those who have attempted to refute it have by their own letters brought into greater prominence the defects of the British Association paper, and tended to exclude from notice the good features to which we referred. The forecast of the future, the advantages resulting from improvements in the means of communication had the right ring. Exaggeration is not desirable in anything, but in that direction it is more permissible. We have pleasure in drawing attention to such points in the paper at the same time that we refer to the proofs which have been furnished of the truth of our statement that the telephoning of great cities is a fine problem, and needs to be handled with a freedom from prejudice, a readiness to profit by the widest experience, a knowledge of the latest tendencies towards improvements, and a comprehension of the requirements of the city concerned.

Telegraphs in Japan.—It is proposed to lay a submarine cable between the mainland to Goto Island and thence to the Loochoo Islands. The estimated cost of the work is over £400,000. The laying of the submarine cable between Echigo and Sado Island is now completed, and the line will shortly be opened to the public.

WOODHOUSE AND RAWSON UNITED, LIMITED.

THE *Financial Times*, in criticising the annual report of this company, says:—

"In the year ending June, 1890, the gross profits were £99,400, in the succeeding year they have been only £74,570. The net profits do not show so badly, being £51,440, against 61,080 in 1889-90, but the comparison should properly be with the amount of capital employed to earn these profits. A glance at the composition of the paid-up capital at the close of the two years is instructive:—

	June 30th, 1890.	June 30th, 1891.
Ordinary capital	£94,667	£163,542
Preference capital	112,825	185,265
Debenture capital	87,330	150,692
Mortgages on property ...	26,500	23,500
	£321,322	£522,999

"This enormous increase in the paid-up capital within 12 months contrasts startlingly with the shrinkage in the gross and net profits, and the other figures in the balance-sheet do not improve the position. The amount of capital represented by premises, plant, machinery and tools is only £99,840, against £72,960, while the quantity of stock on hand has increased from £60,280 to £93,700. The amount of money locked up in contracts in hand has risen from £13,050 to £31,460, which may be a hopeful sign, though we cannot quite see it. What we are not at all doubtful about is this, that when the profits are shrinking it is unfortunate that the item of goodwill should be swelled from £90,000 to £98,000, and that whereas £10,000 was set apart last year out of profits towards the reduction of goodwill, not a penny is devoted to the same purpose this time. Moreover, the value of patent rights is now represented at £76,300, against £66,700, only £4,100 being written off, against £7,400 last year. The shareholders seem thus to have got exceedingly diaphonous value for the expenditure of a couple of hundred thousands of capital in the year.

"It must not be forgotten, of course, that Woodhouse and Rawson United is as much a finance as a manufacturing company, probably more so. The shareholders should, perhaps, be delighted, then, that 'sundry investments' stand in the balance-sheet at £119,338, against £11,246 on June 30th, 1890, showing that half of the new capital has been devoted to the purchase of securities of some kind or another. The item might have been more reassuring had the investments been specified, but quite as probably it might not. For the shareholders would scarcely be delighted to find that their capital, presumed to be productive, was locked up in French or German Elmore shares, in International Okonite, or in Epstein accumulators. These may all be excellent things in their way, but they are far too 'sundry' to be included as investments for a fifth of the funds of an alleged industrial company with half a million of paid-up capital. Nor do the efforts of Woodhouse and Rawson United as a finance concern stop here. The company has apparently begun to finance its debtors. Last year sundry debtors owed £59,000—rather a big sum, and £1,214 was due on bills, say £60,200 in all. Now sundry debtors stand in the books at £91,000 and the bills receivable at £4,432, or over £95,000—a 50 per cent. increase. We can quite understand why the directors should out of the diminished profits feel it necessary to start a 'bad debt reserve,' for an item of £95,000 of outstanding credits in a company whose gross profits for a year were only £74,000 is distinctly alarming. And unless the dividend for the June half of this year is to be paid in mortgages on trade debts, or in Epstein accumulators, we do not see where the money is to come from. At the close of June, 1890, the company had £51,518 in cash, with which to pay half-yearly dividends, absorbing only £12,576, while now there is but £5,989 in cash with which to pay dividends amounting to £16,043. This operation is likely to want a good deal of financing, and perhaps the necessity of attacking such a problem is the reason why the directors are thinking of bringing out some more foreign Elmore Copper companies. The profits of a fat promotion would come in very handy just now, but we fear the best days of Woodhouse and Rawson promotions are over.

"How long Woodhouse and Rawson United can last as a dividend-paying concern seems to reduce itself to an arithmetical problem, which the shareholders may work out for themselves. The factors in the problem are simple enough. You have gross profits reduced by exactly 25 per cent. and net profits by nearly 18 per cent., while dividends have increased nearly 63 per cent., from £18,749 to £30,507. Over £16,000 was brought from 1889-90 into 1890-91, and only £8,900 is taken out, so that the previous year has supplied one-fourth of the dividends declared and all the balance carried forward. In point of fact, then, the year 1890-91, so far from earning the 15 per cent. dividends declared on the ordinary shares, has earned only 7½ per cent., and that though a very energetic attempt seems to have been made to cut down expenses. Salaries (which are no longer described as including managing director's and managers' commissions) have been cut down from £23,270 to £15,200, and but for the great increase in the debenture interest the profit and loss account would have shown a fair reduction on the expenditure side. But something more than a reduction of salaries will be required to put this lop-sided concern in trim. We ask the shareholders if they think half a million of money, besides the reserve and other items aggregating altogether £626,000, is properly represented by £100,000 in premises and plant, £126,000 in stock and half-finished work, £95,000 in 'sundry' debts, £98,000 in goodwill, £76,000 in patents, £119,000 in 'sundry' investments, and only £6,000 in cash? We certainly never saw a more ragged or less liquid catalogue of assets set forth by an important company, which, to add to its financial faults, masquerades before the public as able to pay 15 per cent. per annum out of legitimate business."

REVIEW.

Electric Transmission Handbook. By F. B. BADT. Electrician Publishing Company, Chicago. London: ELECTRICAL REVIEW office.

Mr. Badt's "Handbook series" are well known, and the newest one before us on the subject of the electric transmission of power, will supply those interested in this question with useful data and tables, such as they would have to search for in many more voluminous books or periodicals. The author does not claim originality, and makes copious use of the most important publications, including Mr. Kapp's recent Cantor lectures so far as given in the articles of the ELECTRICAL REVIEW of February last, as the verbatim reports of the Society of Arts had not yet appeared at the time of the publication of the handbook. Mr. Badt answers the question: "Is electric power transmission a practical and commercial success, and not a mere experiment?" by the publication of the following statistics referring to plants in operation in the United States on January 1st, 1891.

	H.P.	Capital invested.
Arc and incandescent lighting	390,000	$128,000,000
Electric railways	106,000	50,000,000
Stationary motors on independent power circuits	26,000	9,000,000
Total	522,000	$187,000,000

It is scarcely necessary to dwell upon the importance of these figures, which will be deemed more eloquent than any words we could use to impress our readers with the vastness of American enterprise.

The author discusses all the factors entering into the problem of electric transmission in a practical manner, and he gives 22 illustrations, and 27 useful tables for handy reference. The questions of commercial efficiency, interrelation of electromotive force, current, distance, cross-section and weight of conductor, as well as the conditions for minimum initial cost of transmission plant are well handled, nor is the truism superfluous that "no system of transmission will be profitable if the cost of the power at the distant end is not less than the price which would have to be paid for its production there by water, steam, or some other agency."

In addition to details relating to the subject title, we find rules and formulæ for ascertaining the horse-power of motors driving various classes of machinery, pulleys, belts, and shafting, wire gauges, and data on water power. The work, like its predecessors, is in pocket-book form, it is well printed, and it contains a vast amount of information within the space of about 100 pages.

NOTES.

The Taunton Electrical Engineering Exhibition.—Since its opening on the 1st August, over 18,000 have visited this exhibition, which was closed last week.

Personal.—Mr. Joseph Pyke, director of the London Electric Supply Corporation, Limited, has joined the board of the Weymersch Electric Battery Syndicate, Limited.

Aberystwyth and Electric Light.—At a meeting of the Aberystwith Town Council held last week, it was decided that application be made to the Board of Trade, on or before December 21st next, for a provisional order, to supply electricity for public and private purposes, and to supply electric energy within the borough, and for all incidental and necessary powers.

Electric Lighting of Glasgow Bridges.—The lighting of the Glasgow bridges is occasioning considerable discussion amongst the inhabitants of that city. They are said to be improperly lighted, and altogether in a bad state; seeing that the corporation are considering the advisability of adopting electricity in various parts of the city, a hope is expressed that the whole of the bridges may receive the first installation.

Electric Lighting in Liverpool.—The second largest installation of electric lighting in Liverpool, has been put in Messrs. Henecksberg and Ellis's University House, Islington, by Messrs. A. Hall and Company of that city. The shop is lighted by 140 glow lamps, the windows are fitted with electroliers and shell lights, and the turret is surmounted by a twenty-ampère arc lamp, which is visible from the Welsh mountains, and will form a beacon-light for mariners entering the Mersey.

Electricity at the Mumbles.—Ere next "season" it is not improbable that the Mumbles Local Board will seriously consider the advisability of substituting electricity for gas, with which the place is but inadequately lighted, and at a cost which, in comparison with other towns, is exorbitant. There are no local gasworks, and the gas is obtained from works five or six miles distant. A well-known electrical engineer offered to carry out the installation for £1,100, and keep it in proper working order gratuitously for a year. Were the authorities to decide on the substitution there would be no difficulty in obtaining the necessary sanction from the Local Government Board.

The Preparation of Cinnabar by Means of Electrolysis.—Cinnabar is now being prepared by means of electrolysis, according to a French contemporary, from the metal, mercury, itself. The apparatus seems to be simple, and it is stated that the process is economical, while the product is of excellent quality. A vat, a metre in diameter, and two metres in height, is the chief feature in the plant. On the sides of this vat are fixed two round metallic plates, each 15 centimetres in diameter. The mercury is placed in the vat, and the plates are connected up to the positive pole of a dynamo machine. At the bottom of the vat is a plate of copper covered with galvanised iron: this is connected to the negative pole of the machine. The vat is filled up with an aqueous solution of ammonium nitrate and sodium nitrate, and there is an ingenious device for supplying a constant and regular flow of sulphuric acid. The nitrate solution should contain

Ammonium nitrate	...	...	8 kilogrammes.
Sodium nitrate ...	...	...	8 "
Water ...	...	...	... 100 litres.

The liberated gas escapes by a tube in the cover of the vat, and in doing so, maintains the liquid well mixed; and a precipitate of sulphide of mercury—cinnabar—falls to the bottom.

Song for an Electrical Audience.—A correspondent, who takes a keen interest in the Electro-Harmonic concerts, expresses his regret that he could not attend the last, but to show that he was there in spirit he sends the following parody on the Jacobite song "Loch Lomond," which, arranged by Malcolm Lawson, was sung by Mr. Arthur Thompson at the meeting of October 2nd. Naturally the words "high" and "low" would be interchangeable to suit the singers of the refrain, and the new arranger whose name might possibly rhyme with Lawson, and that of the electrician-vocalist may be left to the fancy of our readers.

ELECTRIC LIGHT SONG—"Old London." Not too Traditional.

By yon busy road and by yon busy street,
Where the gas shines dim on old London,
Where rival contractors were ever wont to meet,
In the fog and the dirt of old London.

Oh ye'll tak' the "*high*" road and I'll tak' the "*low*" road,
And I'll pay a dividend afore ye;
But we and the investor we'll never meet again,
As we did in the old days in London.

'Twas there that we chummed with the stockbroker when
The Boom was a-booming in London;
Where in rosy hue each prospectus we'd review,
And the profits rather hazy in the gloamin'.

O ye'll tak' the "*high*" road, &c.

Promotion 's still the thing, the promoter 's on the wing,
And the present time is suited for floatatin';
But the burnt investor kens the fire will burn again,
Tho' prospectuses may state that it is coolin'.

O ye'll tak' the "*high*" road, &c.

Non é Ver.—The *Engineer* must have an old-timer on its staff, judging from the following expressions in its recent article on "Electrical Railways." "The electricity having done its work goes to earth through the rails." "There are obvious objections to the overhead wire, and crossings and sharp curves present astounding difficulties to the electrical engineer. The gearing is another serious trouble. The overhead wire is, however, *the* difficulty, and a source of danger answerable for numerous deaths and serious accidents." If the writer were *au courant* with transatlantic practice he would not have wasted his time in placing on record such obvious absurdities. The "astounding difficulties" are simply child's play to American engineers, and the numerous deaths from overhead tramway conductors exist but in the scribe's fervid imagination.

Electricity as an Adjunct of Adulteration.—At the meeting of the Bavarian Society of Applied Chemistry, held last month in Augsburg, the subject of the presence of copper in preserved vegetables was under discussion. This discussion was epitomised in the *Chemiker Zeitung*. One of the speakers, Director Kochler, of Berlin, made a rather remarkable statement. He said that during a visit to the Strassburg Exhibition his attention had been attracted to the remarkably beautiful green colour of some preserved beans, and upon inquiring as to how this colour had been imparted he was told that it was a trade secret. Subsequently he had learned that during the boiling of these vegetables in a copper vessel an electric current was passed through the whole, the copper of the vessel acting as an anode, and that in this way a large quantity of copper was carried into solution, giving the vegetables a fine tint.

Chislehurst Electric Lighting.—In accordance with a resolution passed at their last meeting, the Chislehurst committee of the Bromley Rural Sanitary Authority, last week, received a deputation from the Provincial Electric Lighting and Supply Company. Mr. Smee, the company's solicitor, said the reason they had selected Chislehurst was that Mr. Willett, who had erected a large number of houses on the Camden estate, proposed "wiring" every house on to an electric supply, and, instead of gas, providing only the electric light. The company had taken into consideration the various methods for conveyance of electric power, and they would adopt the low tension system as the safest and also as possessing other advantages, besides being recommended by the Board of Trade. At the end of forty or forty-two years, the company would be compelled to sell, but in all probability they would be doing so before that time. The present capital was a mere nominal one of £1,000, it being desirable before inviting capital to see whether the local authorities' consent could be obtained, in which event the company would then readily find the requisite capital. It was resolved to defer any discussion until the publication of notices and plans by the company, which must be published this month.

Conventional Electricity.—There are many curious ideas which linger in the academic mind, and will, it is to be feared, never be eradicated. For instance, says *Industries*, probably nine-tenths of the writers of text-books appear to think that electrical engineers use sine and tangent galvanometers for measuring, let us say, dynamo currents. Another established idea is that dynamos have something called a "critical speed," and that dynamo makers experiment to determine it. Dynamos have been turned out by the hundred without the makers knowing what a critical speed may be. Again, makers have worked for years to design voltmeters and ampèremeters to give proportional readings. It is needless to remark that voltmeters should have their scales spread out near the standard pressures, while ampèremeters should have similar scales for some purposes, and logarithmic scales for others. No instrument has yet been designed to give a logarithmic scale. The back electromotive force of the arc is now an old-established and eminently respectable phenomenon. Yet an electro-chemical pressure of thirty odd (very odd) volts is extreme, and there is no evidence to show that the conductivity of the arc does not vary as the cross section, and approximately as the current.

Western and Brazilian Telegraph Company, Limited.—The Western and Brazilian Telegraph Company, Limited, notify that code and other messages are transmitted over their system without any restriction or censorship whatever.

Neath Lighting.—A Local Government Board inquiry was held at Neath a few days ago in connection with an application on the part of the Corporation to borrow £2,250 for lighting purposes. It was shown in evidence that the gasworks were incomplete, and that the town was not properly lighted. The Commissioner said he would report to the Local Government Board on the matter.

American v. European Work.—The clerk of the Massachusetts State Board of Gas and Electric Commissioners, Mr. W. A. Allen, after recently spending two months in visiting this country and the Continent, says that wherever he went he found only the very best work being allowed and used, and that he is of opinion that American electricians have yet much to learn from the practice on this side of the water.

The Electric Light in Brussels.—The Electricity Committee and the Fine Arts Section of the Brussels Communal Council met last week to examine the various projects submitted to it for the electric lighting of the Grand Place. A large number of suggestions had to be gone through. It was eventually decided to make experiments with posts from 4 to 6 mètres in height, at the end of which the lamps were to be hung. These experiments are to take place within a few days with four lamps.

Electric Lighting at Tiverton.—The Tiverton borough surveyor laid before the Town Council, on Friday last, his report on the introduction of the electric light into that town. He recommended the Council to advertise for offers from persons or companies to undertake the powers of the provisional order for a specified term. In the course of a discussion the surveyor said he believed that water power from the Exe could be obtained to light the town. The chairman of the Electric Lighting Committee said he was in favour of the town undertaking the work. They would have to make use of water power, which would mean a saving of £800 a year to the town. To lay down an electric light installation would cost about £15,000, which they could borrow for thirty years. The interest and repayment of principal would be £800 per year, and the working expenses, £500. Those figures compared favourably with what the Council were paying for gas (£700 per annum), as they could reckon on receiving £700 for private lighting. He believed they could work the scheme at a profit to the ratepayers. The surveyor's recommendations were adopted.

Co-operative Excursions to the Chicago Exhibition.—The committee of the Polytechnic Institution, Regent Street, London, is arranging trips to the Chicago Exhibition, in 1893, specially intended for working men and others of limited means. The authorities have already entered into a contract with the Inman Steamship Company, and parties will leave Liverpool, weekly, during the months of June, July, and early part of August, by the magnificent steamers, *City of Paris*, *City of New York*, *City of Chicago* and *City of Berlin*, and the whole tour will be able to be accomplished within one month. The committee hopes that the whole excursion, including accommodation for the period, will not exceed 25 guineas. Arrangements have been made thus early to enable those who desire to take part to put by so much per week towards the required amount; also to enable many who have, as a rule, but a fortnight's holiday, to forego their holiday next year, and get a special holiday of one month in 1893. Already over half the places have been applied for. Mr. Douglas Hogg (the son of Mr. Quintin Hogg, the president of the Polytechnic) and Mr. Mitchell, the secretary of the Polytechnic, leave England shortly to complete the trans-Atlantic arrangements. Last year special series of excursions were run to Norway, Madeira, the Ardennes, Switzerland, &c., and during the last three years over 9,000 persons have participated in the excursion arrangements of this well known institution.

Clontarf Lighting.—At a meeting of the Clontarf Township Commissioners it was resolved to make inquiries as to the expense and cost of having the township lit by electricity.

Aberdare Butchers and Electric Lighting.—At a private meeting of Aberdare butchers and cattle dealers, held last week, it was decided that a company be formed for the purpose of building a new slaughter house, which will, perhaps, be the first building of the kind lighted by electricity.

Canterbury Electric Lighting.—At a meeting of the Electric Lighting Committee last week, it was decided to recommend the Town Council to make over the provisional order obtained for Canterbury to the Brush Electrical Company on certain conditions.

Telegraphing Vessels Passing "The Sound."—A circular just issued by the London Chamber of Commerce, states that the Committee of Lloyd's will shortly have under consideration the question of having vessels passing "the Sound" telegraphed from Elsinore daily. To have all sailing vessels and steamers telegraphed would be costly, but steamers might be telegraphed at a moderate expense.

The Electric Light in American Coal Mines.—The coal mines belonging to the H. C. Frick Coal and Coke Company, of Pittsburg, Pa., which are probably the largest in the United States, are being lighted throughout with the electric light. Each mine is being fitted with a separate plant, all of which are being put down by the Westinghouse Electric and Manufacturing Company of Pittsburg, Pa.

Telegraphic Communication with the Seychelles Islands.—A Reuter's telegram, dated Mahé, October 16th, says:—At a meeting of the Legislative Council, held on the 10th inst., a vote of £1,000 per annum was passed as the Seychelles contribution to the telegraph subsidy for the proposed cable to connect Zanzibar with these islands and Mauritius.

Electric Lighting in Wales.—It has been decided to light several collieries and tinplate works in Glamorganshire with electricity. The electric light as an illuminant in Welsh collieries and kindred works is gaining in popularity, and is being extensively adopted. Various works in the Rhondda Valley are already lighted with electricity, whilst the number of electrical engineers in the district has correspondingly increased.

Electricity in Oyster Culture.—It might be thought that electricity would be about the last adjunct to employ in studying the culture of the succulent bivalve. An application of it, however, has recently been made by Mons. Lacase-Duthier, the well-known authority on oyster culture. He makes use of the electric light in examining the stages of development through which the spawn passes. A glass cylinder is mounted in a cylindrical skeleton cage which serves as a support, into this glass the water containing the spawn is placed. At the bottom is a plane, silvered reflector, the cover forms a parabolic reflector in the centre of which is fixed a small incandescent lamp. The reflectors and the sides of the glass cylinder act in such a way that but few rays of light emerge from the apparatus directly, hence the liquid is suffused with a soft illumination which is admirably suited to the examination of the contents. This little apparatus, or a modification of it is now being employed in various researches into the life processes of ferments and the culture of microbes, the illumination by the incandescent electric light being much more suitable for the study of these low forms of life than that from other artificial sources.

Portraits.—As a supplement to our contemporary, *Machinery Market*, for November, a portrait is given of Professor Silvanus Thompson.

The Suggested Electric Railways in Berlin.—The local authorities of Berlin are now examining the projects advanced respectively by Messrs. Siemens and Halske for an elevated railway, and by the General Electricity Company for an underground system consisting of three lines. The capital which would be required for the construction of the lines would be raised by the firms concerned, who do not ask for subsidies. At the general meeting on the 31st ult. of the Berlin Electricity Works, the directors stated that in the event of the General Electricity Works obtaining consent to the construction of the proposed underground electric railway in Berlin, they would provide the necessary current.

A New (?) Solution for Electric Batteries.—Ladies have demonstrated their capabilities in many directions during the last few years, but few have done much in applied science; indeed, we believe we are within the mark in stating that no lady has hitherto distinguished herself in the application of electrical science. A few weeks ago, however, a Yorkshire lady added one more to the long list of patents which refer to electric batteries. It is almost a pity that the lady in question should have chosen such a well trodden track in which to exhibit her inventive energies, but perhaps there will be more originality in the future. The lady's invention refers to a "new or improved solution or composition for charging electric batteries." This solution is composed of the following ingredients :—

Sulphuric acid solution	...	1 to 6 parts of water.
Bichromate of potash	...	10 per cent.
Sulphate of iron ...	...	10 „
Chloride of sodium ...	...	25 to 50 per cent.
Chromic acid or Sulphate of copper	...	5 to 15 „

By increasing or decreasing the quantity or proportion of the ingredients the power or efficiency of the battery can be regulated.

Electricity and Yeast Culture. — Some remarkable results have recently been witnessed in applying electricity, more especially the electric light, to plant culture. Now, from plants to yeast seems a long step, but a perfectly legitimate one, for the various forms of yeast are no more nor less than low types of vegetable life, and there seems no reason, *primâ facie*, why, if electricity can prove useful in horticulture, it should not also be of service in ferment culture. A short time ago it was observed that certain rare tropical plants, *e.g.*, orchids, are better able to survive the dangers of a long sea voyage if, instead of being shut up in dark boxes, they are exposed to the electric light. Some of these plants cost fabulous sums, and are obtained with great difficulty, and it is not uncommon to find a shipment very badly damaged because the cases have been kept dark. It is now proposed to illuminate these cases by incandescent lamps, and it is believed that the expense will be well recouped, because the plants are of such a high value. A writer in the current issue of the *Brewer's Journal* in commenting upon this proposal, says there is no question that yeast flourishes far more vigorously in a well lighted fermenting room than in one that is altogether too small, and in which the atmosphere is close and the light feeble or nil. He suggests that since the electric light can enable these rare tropical plants to retain their life action during a long voyage under conditions that are in every way bad for them, it might be well to apply it to the fermenting rooms of breweries; and he believes that good illumination would undoubtedly favour the development of yeast, especially during the concluding stages of fermentation. Of course, neither gas nor oil illumination would be suitable for this purpose on account of the noxious fumes which are given off. There could be no such objection to the incandescent light, and we should very much like to see some enterprising and intelligent brewer giving the electric light a fair trial.

The Storm and Telegraphs.—In consequence of the storm on Wednesday last telegraph communication with the continent was interrupted. The receipt of any telegraph advice from the East was also prevented. In London a number of wires were broken down.

The City and South London Railway.—A representative of the *Daily Oracle*, on making enquiries as to the circumstances of the City and South London Electric Railway under the changed conditions of higher fares between 8 a.m. and 10 a.m., and the issue of season tickets, learned from the company that there has been no falling off in revenue, if in numbers, by the change to higher rates, and that the season-ticket holders are numerous. The receipts are well maintained. A new Siemens locomotive of greater power than the locomotives in use has been added to the rolling stock, and another is to follow. Very soon it is hoped that the train service will be accelerated, and the distance from Stockwell to the City covered in 12 minutes.

The Telephoning of Great Cities.—After our "Correspondence" columns had gone to press we received the following letter from Mr. Ernest J. Gillett. We need only remark that in his comparison Mr. Gillett omits to take account of the improvements which have been made in both systems :—"I have followed with much interest the correspondence which has appeared on this subject. Having had some experience in the working of the original Law exchange system in Brooklyn and New York in the early days of telephony, some remarks thereon may be of interest to your correspondents. In Brooklyn two systems of running the call circuit were employed, the first and most favoured being a metallic loop into which the subscriber introduced his instrument in series, the second method being a *single wire with spur connections earthed through the subscriber's instrument* on his pressing the call button (now, I believe, called Mann's system). The subscriber's main wire in the exchange ended in a horizontal switch table, no indicators being used. The connections between subscribers to the Law Company were certainly more quickly made and detached than in any of the indicator systems then working in New York. I consider that the complaints of the subscribers to the Law system were due to a general variety of defects in its design and construction, which to-day, with our vastly improved knowledge and experience of telephony, compared with 10 years ago, can be almost entirely overcome. The principal defects of the system were due to the following causes :—High resistance of circuits due to the employment of iron and steel wires of small diameter and bad joints thereon. Overhearing. Contacts between the line wires, and not the least, breakdowns of the call circuits, due principally to bad contacts in the call-keys. The Law subscribers' instruments were not provided with generators or batteries for calling other subscribers. I thought, and still think, this false economy. I consider that even on call-wire systems it is an advantage for subscribers' instruments to be furnished with magnetos, enabling them as it does to recall each other, it frequently happening in conversation between subscribers that—say No. 1 requires some information which takes his correspondent a few minutes to obtain. No. 1 either has to wait telephone to ear whilst it is being obtained, or No. 2 has to take up the attention of the operator who has to get No. 1 recalled. There is also another very important point in favour of the call circuit system which has not received the prominence in the discussion which I consider it deserves. I refer to the much greater intensity and clearness in the transmission of the voice due to the total absence in the circuit of either call or ring-off indicators. Subscribers to the London exchange system would appreciate this advantage. I have always had a very high opinion of the call-wire system, which an exclusive experience of annunciator exchange working has not modified, and I think that, given thoroughly efficient and well-designed instruments, metallic circuits (and providing against breakdowns of the call wire by using Mr. Miller's happy suggestion), time will prove that this system possesses many advantages over its rival in economy of working, rapidity of connection and disconnection between subscribers, and in clearness of transmission."

The United States Electric Street Railways.—Nearly one-half the street railways of the United States are operated by electricity.

Progress of Electric Lighting in St. Pancras.—Electric current was supplied for the first time on Monday night to a few customers.

Old Rails as Telegraph Posts.—The G. I. P. railway in India are now utilising their old rails as telegraph posts, for which purpose they are considered to be very effective, being both cheap and durable, as well as strong and inflexible. It may be remembered that this idea was first carried out by Mr. R. G. B. Davids in Brazil, and described in the REVIEW of May 1st, 1878.

New Engineering Magazine.—We have just received a copy of the first number of *Cassier's Magazine*, a journal devoted to engineering. It is beautifully printed, copiously illustrated, and, judging from the articles it contains on steam engines, shafting, subdivided power, the coal bill, boiler plates, electric pumping machinery, &c., from the pens of competent authorities, it will be much appreciated amongst those for whom it caters.

Society of Arts.—The first meeting will be held on Wednesday, November 18th, when the opening address will be delivered by the Attorney-General, Chairman of the Council. On the following Wednesday evenings previous to Christmas papers will be read on "The Measurement of Lenses," by Prof. Silvanus P. Thompson; on "The World's Fair at Chicago in 1893," by Mr. James Dredge; on "Secondary Batteries," by Mr. G. H. Robertson. Among the following courses are four lectures on "The Developments of Electrical Distribution," by Prof. Forbes, which will be delivered on January 25th and February 1st, 8th, and 15th. A special course of lectures has also been arranged, under the Howard Bequest, on "The Development and Transmission of Power from Central Stations," by Prof. W. Cawthorne Unwin, F.R.S., commencing shortly after Christmas.

World's Fair, Electricity Hall.—A *Times* telegram from Chicago states that the large structure in the World's Fair buildings known as Electricity Hall has been declared unsafe, and the architects are debating whether they will tear up the foundations and do the work over again, or endeavour to strengthen the substructure. The building has been so badly planned that it would, when completed, scarcely sustain its own weight, and at least $75,000 will be required to make it safe. All the large structures have now been condemned as unsafe. This puts one in mind of the celebrated American bridge, the strength of which was calculated to such a nicety for the weight of the train which usually ran across it, that no margin of safety had been allowed for the weight of a cow which one day strayed upon it, and when the train came along and tossed the animal against the parapet, the whole structure collapsed.

The County Council and Electric Lighting.—Under this heading a letter appeared in the *Times* yesterday from a citizen who seems to have good cause for complaint. He thinks the County Council are a little remiss in the performance of their work-a-day duties. One of these duties is to protect the public by testing and certifying the accuracy of the meters supplied by electric supply companies. The writer stated that he was informed by one of these companies who ought to be supplying him with light that they have had 100 meters in the hands of the County Council for six or seven months, and cannot get them back, and that they do not know how much longer he may have to wait before they can put in a meter. He has already lived nearly two months with his gas put out and nothing to replace it. He cherishes the hope that the insertion of his letter may perhaps induce the County Council to moderate their policy of neglect. We hope it will.

The Electric Light in Austria and Hungary.—The electric lighting installation for the town of Arco is making satisfactory progress, and numerous applications for the supply of current have already been received. A project has been laid before the civic authorities of the town of Prague by Herr Krizik, engineer for the electric lighting of the Altstadt. It has been decided to adopt the electric light as the means of illumination in the town of Serajevo, and a sum of £18,000 has been put aside for the purpose of carrying out the installation.

Hastings Electric Light.—It is stated that during a dinner given by the Mayor of Hastings, at the Albany Hotel, to the Recorder, Corporation, &c., on the 28th ult., at which were present Lord Brassey, Viscount Cantelupe, Mr. Wilson Noble, M.P., and upwards of 70 guests, the whole of the electric lights went out, and the party were in darkness until the gas could be brought into use. It is also said that recently the whole of the 15 arc lights on the Parade and on the Hastings Pier were out for ten minutes.

Factory Lighting.—The electric light is now being installed in Messrs. Abbott, Anderson and Abbott's India-Rubber and Oilskin Works, Dod Street, Limehouse. The installation will consist of 300 incandescent lamps, the current being supplied by an 18-unit compound-wound dynamo, and the motive power being furnished by a Tangye's horizontal engine. About half the total number of lamps are working at present, and the results obtained are in every way satisfactory. The contractor for the work is Mr. A. H. Wood, Chesterfield House, Great Tower Street, E.C.

Institution of Civil Engineers.—The opening meeting of this institution was held on Tuesday last. In the course of his inaugural address the president (Mr. George Berkley) said that, in regard to the Suez Canal, vessels not using the electric light were nearly 38 hours in passing through, while vessels which used it passed through in 22½ hours, thus saving 40 per cent. of time, and increasing the carrying capacity of the canal. In 1890, 3,389 vessels, of which 2,522 were English, passed through the canal, and 2,832 at night with the aid of electric light. He also referred to the progress in telegraphy, telephony, electric lighting, and the electric transmission of power; and the experience acquired by the authorities of the General Post Office was cited.

The Crystal Palace Electrical Exhibition.—A meeting of the Honorary Council of Advice, and of the Special Committee appointed by the Electrical Section of the London Chamber of Commerce, will, by kind permission of the Lord Mayor, be held at the Mansion House at 3 o'clock on Wednesday, the 25th inst., when a report on the progress of the exhibition will be presented, and the question of how the exhibition may best be used as a means of advancing the interests of electrical science will be considered. The Lord Mayor will preside. The whole of the space is now practically allotted, extra buildings having been erected for certain large installations which could not otherwise have been accommodated.

Proposed Electric Lighting at Worcester.—The recent canvass by Mr. Oswald Swete of the citizens of Worcester as to their willingness to take the electric light, resulted in promises equivalent to about 14,000 10-C.P. lamps being provisionally given. The price suggested was 7d. a unit, equal to gas at 4s. 6d. per 1,000 feet. A meeting of the Watch Committee was held last Friday, when the subject of electric lighting was discussed, and it was resolved to recommend the City Council to authorise the committee to invite plans, descriptions and estimates for the construction of electric lighting works necessary to enable the council to supply electricity equivalent to 12,000 10-candle-power lamps. But how does Mr. Oswald Swete make the unit at 7d. equal to gas at 4s. 6d. per 1,000? We have hitherto been under the impression that the latter would work out at 7s.

Electricity in Printing Offices.—The printing machinery of the *Age* of Belfast, Me., U.S.A., is now driven by an electric motor.

Gas and Electric Light in Lisbon.—The two gas companies which existed in Lisbon have now amalgamated under the title of "The Compagnies réunis de Gaz et d'Electricité.

Electric Railway at Singapore.—An experimental trial with an electric railway recently took place at New Harbour, Singapore. The projector has in view the running of an electric railway to Johore along Bulit Timah Road, and he has approached the Government on the subject.

The Electric Light in the Strand.—We announced last week that Messrs. John Pound & Co., of Leadenhall Street, E.C., cutlers and travelling case makers, had recently added an electrical department to their business. We now learn that they have fitted their branch establishment in the Strand throughout with the electric light.

Provisional Orders—Finchley and Shoreditch.—Last Tuesday's *London Gazette* announces that the Finchley Local Board, also the vestry of the parish of St. Leonard, Shoreditch, intend applying for provisional orders for electric lighting and otherwise supplying electricity, to be confirmed by Parliament in the 1892 session.

Dublin Castle.—The Government has decided to illuminate the state apartments of the castle with the electric light. The contract for doing so has been given to the firm of Edmundsons, Limited, who are working to the specification of Mr. Preece. There will be about 600 lamps, which will eventually extend to 2,000. The lighting of the National Museum and Library in the same place and by the same firm is very much admired, and leaves little to be desired.

Standard of Light.—Our contemporary, *Industries*, states that it would appear from a recent report of the Sanitary and Special Purposes Committee of the London County Council, that it is again complaining of its inability to do anything in the matter of altering the present standard of light. It has, however, at last been admitted that the present "Parliamentary candle" is a most unsatisfactory standard, but although the Board of Trade in a recent communication, to the council assented to the appointment of a scientific committee to consider what the standard of light should be neither the committee nor the Board of Trade are able to find the necessary funds for such an inquiry. It is strange that both these bodies should complain of want of funds at the same time, especially as it is ten years since the Board of Trade appointed a committee for this purpose. Our contemporary asks in all seriousness why the Board of Trade think it necessary to have a new scientific committee to report on this question, when the last report still remains available as a basis for new legislation. Is the County Council—which has decided to introduce a Bill next session—forbidden to utilise the former report, or is it intentionally putting difficulties in the way by a long and useless correspondence with the Board of Trade? The County Council seems inclined to ignore what has been done in the past, for there is not only existing the report of the committee of the Board of Trade of 1881, already alluded to, in which the adoption of the pentane air gas standard is recommended, but also resolutions passed by the Metropolitan Board of Works in 1887 and the standards of light committee of the British Association of 1888 in favour of the same standard. It is possible that the tardiness shown in this matter is in part due to the modesty of the acting metropolitan gas referees? It is to be hoped that the new Bill will decide (1) the new standard, and (2) the photometer to be used therewith, not only in the testing stations controlled by the London County Council, but throughout the provinces.

Electric Lighting in Coal Mines.—It is stated that the directors of the extensive collieries at Wharncliffe Silkstone, have decided to introduce the electric light into their pits.

Fire.—The well-known old family mansion, Park Hall, Gateshead, now connected with the foundry and electric lighting works of Messrs. Clarke, Chapman & Co., was almost completely destroyed by fire last Tuesday. The Hall was used by the above firm as a drawing office.

The Latest Professor.—The English correspondent to the New York *Electrical World* says:—"The Glasgow municipality is still perturbed as to the electric light of that city, and has called in *Prof.* Rankin Kennedy as consulting engineer.

An Electric Boat.—M. Trouve has a design for an electric boat propelled by a sea-water battery. The plates are sunk in the sea under the boat by way of a kind of keel, and drive a large rotary wheel by means of a motor. Pulleys raise or lower the plates as required.

Cutting Telegraph Wires in the City.—At the Mansion House, on Wednesday last, Edward Green was sentenced to one month's imprisonment, in default of paying a £5 fine and £4 damages for cutting the Exchange Telegraph Company's and the Boy Messengers and Electric Call Company's wires in St. Paul's Churchyard.

Mafeking and Cape Town—Fort Victoria Telegraph Line.—A telegram from Fort Victoria, Mashonaland, states that the extension of the British South Africa Company's telegraph line from Mafeking and Cape Town to Fort Victoria has now been completed, and an office has been opened at this place.

A Large Plant at Boston.—The electrical plant which is being erected for the West End Street Railway Company, of Boston, U.S.A., and which is now approaching completion, is of large proportions. In the boiler house, which is 160 feet long by 80 feet wide, 24 boilers are being put down to provide steam to 13 engines of the triple-expansion type, each engine being of 2,000 H.P., or a total of 26,000 H.P.

Large Alternating Generators.—What are said to be the two largest alternating generators have recently been supplied to the Missouri Electric Light and Power Company, of St. Louis, Mo., U.S.A., by the Westinghouse Electric Company. These generators, which are of 400,000 watts, are compound-wound and self-regulating, and have a combined capacity of 20,000 lights.

Electric Tramways in Australia.—After being closed for upwards of three months, the Doncaster and Box Hill electric tramway will, it is said, probably be shortly reopened. The company has been reconstructed, and with an increased capital great improvements have been made in the permanent way, and the difficulties with the owners of a portion of the land over which the line runs have been overcome.

Electric Light Cables.—Mr. Stuart A. Russell's new work on "Electric Light Cables and the Distribution of Electricity," will be issued shortly in Messrs. Whittaker's "Specialists' Series." The work, after considering the laws relating to temperature and pressure, and the effect that they have on the determination of the sectional area of the conductor, goes on to describe the various methods of insulating. Chapters follow on the testing of cables, on external wiring, underground work, and the methods of distribution of our various supply companies, to which are added notes on testing circuits in daily use, and on the localising of faults in conductors.

NEW COMPANY REGISTERED.

Globe Electric Company, Limited.—Capital £10,000 in £1 shares. Objects: To acquire, improve, manage, work, develop, sell or otherwise deal with electrical, mechanical and chemical engineering businesses, concerns and undertakings. Signatories (with one share each): R. H. Newington, 4, Berry Street, Clerkenwell, electrical engineer; J. Coventry, 45, Addison Gardens, W.; V. M. Mercer-Adams, Bracknell, Berks; A. R. Margary, 9, Wynne Road, S.W.; E. Priddle, 4, Berry Street, E.C.; J. E. Batchelor, Stock Exchange, E.C.; T. H. Chiles, 71, Queen Street, E.C. The regulations of Table A mainly apply. Registered on the 4th inst., by Messrs. Gover and Chiles, 71, Queen Street, Cheapside, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Gordon Electric Traction Company, Limited.—The statutory return of this company made up to the 24th December, 1890, was filed on the 5th inst. The nominal capital is £2,400 in £10 shares. 172 shares have been taken up, 60 of which have been issued as fully paid. Upon the remainder the full amount has been called and £860 paid, leaving £260 unpaid. Registered offices at the offices of Messrs. Merryweather and Sons, Greenwich Road, Greenwich.

Ogmore Valley Electric Light and Power Supply Company, Limited.—The statutory return of this company, made up to the 22nd ult., was filed on the 4th inst. The nominal capital is £10,000 in £5 shares, 569 of which have been taken up, £1 per share called, and £434 10s. paid, leaving £134 10s. unpaid. Office: 2, Wyndham Villas, Nantymoel, near Bridgend, Glamorganshire.

Brush Electrical Engineering Company, Limited.—The registered offices of the above named company have been removed to Albert Buildings, 49, Queen Victoria Street, E.C.

British Electric Installation Contractors, Limited.—The first registered office of the above named company is situate at Angel Street, Worcester. (Filed 7th inst.)

BUSINESS NOTICES, &c.

Cox-Walkers.—Messrs. Cox-Walkers, of Darlington, have obtained the contract for the supply of all the material and apparatus for the San Cebrian Railway telegraph, signalling, and telephone lines, and are now shipping a first instalment to Spain *vid* Liverpool. They have also just completed the electric lighting of Craig Crook Castle, using a petroleum oil engine for motive power, with very satisfactory results. They have also made an arrangement with the National Telephone Company, enabling them now to recommence the "royalty paid" manufacture of their old legally-celebrated and favourite "Hunnings" transmitters, and Cox-Walker magnetic telephones.

The late Liepmann Carbon Company.—Messrs. Nicholson, Bolton and Tyler, of 100c, Queen Victoria Street, E.C., inform us that they have purchased the stock of the late Liepmann Carbon Company, Limited, of Millwall, and are placing them upon the market. We understand that the plant has been acquired by Messrs. R. Bolton & Co., of 110, Leadenhall Street, E.C.

Electrical Engineers Wanted.—The Corporation of Huddersfield are inviting applications from electrical engineers to superintend the execution of the works; the contractors for which are the Brush Electrical Engineering Company, Limited. Applications to be addressed to the Town Clerk, Town Hall, Huddersfield.

Brush Electrical Engineering Company, Limited.—The arrangements for lighting the banqueting chamber and the arc lamp outside the entrance to the Guildhall, for Monday last, were carried out by the Brush Electrical Engineering Company, Limited.

Charlesworth, Hall & Co.—Messrs. Morrison and Harper, 135, Buchanan Street, Glasgow, are no longer agents for the above firm. All enquiries in future, therefore, should be sent direct to Messrs. Charlesworth, Hall & Co., at their works at Werneth, Oldham.

Barnett Wynne and Barnard.—This firm have removed from Newcastle-on-Tyne to their new works at Walker, and all communications in future should be addressed, Messrs. Barnett Wynne and Barnard, Volt Works, Walker, R.S.O., Northumberland.

Woodall and Son.—A new catalogue of electric shades and globes manufactured by Messrs. Woodall and Son of St. George's Glass Works, Birmingham, has just been issued containing illustrations of coloured, cut, and fancy glass articles, as well as patterns of Hall's registered ship globes specially suitable for saloons of first class passenger ships.

John Walsh-Walsh.—This well-known maker of fancy coloured glassware has just brought out two new tints for electric light shades and similar articles. Both the new heliotrope ware and the straw opalescent are of most delicate and pleasing colour, and seem specially suitable for interposing between the eye and the light.

Appleton, Burbey and Williamson.—Removal.—This firm announce that they have removed to larger and more commodious premises, at 92, Queen Victoria Street, E.C., to which address all communications should be made.

Personal.—Mr. George North, M.I.M.E. and A.I.E.E., General Manager to Woodhouse and Rawson United, Limited, has resigned his appointment in order to commence business on his own account, at 90, Queen Street, E.C.

CITY NOTES.

The Western and Brazilian Telegraph Company, Limited.

THE twenty-second ordinary general meeting of this company was held yesterday at Winchester House, Mr. W. S. Andrews presiding.

The CHAIRMAN said that before proceeding with the ordinary business he had to announce the resignation of Mr. H. Weaver, one of the directors. This gentleman appeared to think that there were certain incompatibilities in his holding the position, and with his usual straightforwardness had decided to relinquish it. The directors deeply regret losing so highly esteemed and valued a colleague. The board did not, however, intend to fill up the vacancy at present. Regarding the business of the company, the chairman stated that, notwithstanding certain disappointing elements, the receipts remained as they had been lately, of a satisfactory character, and he was pleased to report a very large take on the operations of the half-year. The receipts were £104,962, as compared with £89,846 for the corresponding period, which was an augmentation of £15,115. With reference to the increase in money, he remarked that the increase in the traffic was considerably larger than the increase in money represented. There would have been an addition to their receipts if a certain claim, made under agreement with the Brazilian Company, had been successful. In the end, however, the decision was given against them. That was, of course, only a claim which, in the opinion of those who had to adjudicate, was not a good one. They had made a loss on exchange during the half-year under review of £8,197, but that was no fault of theirs; if exchange had been at par, instead of at serious discounts which it had fallen to sometimes, they would have had an increase of £23,000 instead of £15,000. If a change should take place in exchange in Brazil they would at once benefit by it. The expenses, on the whole, showed a reduction of £1,871; that, of course, being spread over a number of items. There were in all 15 items, six of which were increases and nine decreases. The increases were in the pay of the staff, new men having to be sent out to meet the larger business in 1890. Then there was the night service in 1891; also considerable expense had arisen owing to the state of things in Brazil, and very frequently they had had a large number of resignations which involved replacement, and, of course, expense. There was also an increase in income tax of £182, which no one would object to. The decreases were in connection with the ships. The *Norseman* showed a decrease in expense of £959, and the *Viking* £1,581, but the items were too numerous to go into in detail. The total result was therefore a decrease of £2,540. There was a small increase in the London expenses of £271, and £81 for increased clearing house expenses. Under profit and loss accounts, they had spent £1,344 less upon new cables for repairs. If it had not been for exchange the increase would be £23,000, and extra work representing that money had actually had to be performed. Messages had been worked, only they had not produced quite so much, and the additional work done by the staff during the last half-year represented an increase over the corresponding period of somewhere about 31 and 32 per cent. He complimented the shareholders upon having the foresight to have a good reserve, which had enabled them to pay for new loop cables without calling upon any of the capital. Coming to the question of the long-threatened competition, he said that one of the competitions had been established, and a line laid between Brazil and North America. Up to the present time this new cable had not had the slightest effect on the Western and Brazilian. On October 22nd the new line broke, and he had reason to think that it would be long before it was repaired. The close of the Chilian revolt had brought into the field again their old competitors on the West Coast. He could not say whether they had affected the receipts or not. On the whole he so considered their strong position, and experience would carry them through competitive times. In conclusion, the chairman said that they had decided on account of the competition to cease publishing the traffic returns, which would thus prevent their enemies ascertaining their true position.

After a few questions had been answered the report was adopted.

City of London Electric Lighting Company, Limited.

AN extraordinary general meeting of the City of London Electric Lighting Company, Limited, was held at Winchester House, Old Broad Street, on Thursday the 5th inst., Sir David Salomons, Bart., in the chair.

The SECRETARY (Mr. J. Cecil Bull) having read the notice convening the meeting, the following resolution was proposed by the CHAIRMAN, seconded by the EARL OF SUFFOLK, and carried unanimously:—

"That the special resolution which was passed at the ordinary general meeting of the company, held on the 15th day of October, 1891, as follows:—'That article No. 13 of the company's articles of association be altered by inserting after the words "each call" at the end of the fourth line, the following:—"and that no call shall exceed one-fifth of the nominal amount of a share or be made payable within two months after the last preceding call was payable,"' be and is hereby confirmed."

The CHAIRMAN intimated that this really concluded the business of the meeting, but before separating he would like to say a few words in answer to an assertion he had seen in certain newspapers that he had conveyed an entirely erroneous impression as to the relative cost of gas and electricity.

I will first state that an 8 C.P. glow lamp is usually taken to replace a 5-foot gas burner (at usual gas pressure). The light in each case being approximately equal.

Again, an 8 C.P. lamp requires from 30 to 33 watt hours (*i.e.*, ampère × volt hours), and as a Board of Trade unit equals 1,000 ampères × volt hours, it consequently results that at 8d. per Board of Trade unit the cost comes out that 33 8-C.P. lamps for one hour cost 8d. (if the value of the lamps is excluded).

Thus:—

$$\frac{1,000}{33} = 33 \text{ lamps (8 C.P.) for 1 hour, for 8d.}$$

Now glow lamps last over 1,000 hours before renewal, say 1,000 hours in this case, and each lamp costs 3s. 6d. or 168 farthings; then cost of wear of 33 lamps for one hour is:—

$$\frac{168}{1,000} \times 33 = 6 \text{ farthings} = 1\tfrac{1}{2}\text{d.}$$

consequently, cost of one Board of Trade unit becomes 9½d. when wear of lamp is taken into account,

$$1 \text{ 8-C.P. lamp for 1 hour} = \frac{9\tfrac{1}{2}\text{d.}}{33} = 1{\cdot}\dot{1}\dot{5} \text{ farthings} = 1\tfrac{7}{12}\text{th farthings.}$$

Gas being reckoned by price per 1,000 cubic feet, a foot burner consumes $\frac{5}{1,000} = \frac{1}{200}$ of charged price per 1,000 cubic feet.

Consequently with gas at 2s. 6d. per 1,000 cubic feet, a 5-foot burner costs per hour,

$$\frac{1}{200} \times 2\text{s. } 6\text{d.} = \frac{120}{200} \text{ farthings} = \frac{3}{5} = 0{\cdot}6 \text{ farthings.}$$

Gas at 3s. per 1,000 cubic feet by a similar calculation

$$= \frac{1}{200} \times 3\text{s.} = \frac{144}{200} \text{ farthings} = 0{\cdot}7 \text{ farthings.}$$

Gas at 3s. 6d. per 1,000 cubic feet, similarly

$$= \frac{1}{200} \times 3\text{s. } 6\text{d.} = \frac{168}{200} \text{ farthings} = 0{\cdot}84 \text{ farthings.}$$

Gas at 4s. 6d. per 1,000 cubic feet, also by same method,

$$= \frac{1}{200} \times 4\text{s. } 6\text{d.} = \frac{216}{200} \text{ farthings} = 1{\cdot}08 \text{ farthings.}$$

Gas at 5s. per 1 5-feet burner for one hour costs

$$\frac{1}{200} \times 5\text{s.} = \frac{240}{200} \text{ farthings} = 1{\cdot}2 \text{ farthings,}$$

Consequently, the electric light in point of cost lies between gas at per 1,000 cubic feet, 4s. 6d. and 5s. The actual value being over 4s. 10½d. and under 4s. 11⅔d.

No questions being asked the meeting then terminated.

Woodhouse and Rawson United, Limited.

THE directors' report for the past year states that of the second issue of capital authorised at the last general meeting, namely, 20,000 ordinary shares, 10,000 preference shares, and 100,000 £5½ debenture stock, 9,889 ordinary shares, 7,000 preference and £85,192 debenture stock have been allotted.

The balance sheet shows a net profit of £35,103 9s. 2d., which, with the sum of £16,335 15s. 3d., the amount brought forward from last year, makes a total of £51,439 4s. 5d.

Out of this sum the directors paid in February last an interim dividend at the rate of 8 per cent. upon the preference shares, and 15 per cent. upon the ordinary shares, and they now recommend a further dividend up to June 30th last at the same rates. These payments will absorb the sum of £30,507 16s., and leave the sum of £20,931 8s. 5d. Out of this balance the directors recommend the appropriation of £10,000 to the reserve fund, which will then stand at £35,000, £1,500 to bad debt reserve, and the addition of £500 to the employés pension fund, bringing this up, with interest, to £1,565, and leaving £8,931 8s. 5d. to be carried forward to the current year's account. With a view of enabling the balance sheet to be prepared up to as late a date as possible, the accounts for all the branches are made up to May 31st, stock being taken to that date, whereas the head office accounts are made up to July 31st.

West Kensington Hall, Hammersmith.—During the last year these works have been increased by the erection of a large new factory, 133 feet by 44 ft. and five stories high, fitted with all the latest appliances. The old engines and boilers have been replaced by those of the latest and most efficient type, the old chimney has been pulled down and a large one erected, whilst the foundry has been enlarged and the works generally improved. The cost of the new buildings has been put to capital account, whilst of the cost of moving, £2,000 has been written off revenue account. Although alterations have not been carried out without considerable interruption of the work in hand, the turnover has largely increased, and it is hoped that this extension will enable the company satisfactorily to keep pace with the work offered in this department. The power for the whole of the new factory is transmitted by electric motors placed on the different floors. One of the company's buildings has been fitted up for the manufacture of the Epstein accumulator, one of the inventions mentioned in the report of last year as being tested, and which has more than borne out the expectations that had been formed of it.

Union Foundry at Kidsgrove.—These works have been consolidated, a new boiler shop erected, and new plant put down. The mortgage which was existing on the property when it was taken over has been substantially reduced. The works are at present very busy, and there is every prospect of a considerable development of trade in the future. An extension of this branch has been made by the acquisition of the business of Messrs. Anderson and Gallwey, hydraulic engineers, for whom the Company had been manufacturing, and who have a large number of specialities in hydraulic machinery, now taken over by the company. Mr. Gallwey remains with the company as manager of this department. The patents of Mr. Reginald Bolton for electric cranes and winches have also been purchased, and promise to bring in a considerable amount of valuable business.

Cornbrook Telegraph Works.—These works at Manchester have been extended by the erection of special plant for the manufacture of dynamos and motors, the works having had hitherto a difficulty in supplying the orders in hand.

Supply Department.—This important department has continued to increase rapidly, the turnover for the last year having considerably exceeded that of the previous year, and the net profit has doubled. The increase has been such as to necessitate a wharf being leased for the heavier goods—viz., Lyon's Wharf, Thames Street, E.C. This increase since the date of the balance sheet has been maintained. The acquisition of the new warehouse and showroom is giving satisfactory results.

Installation Department.—A large number of contracts have been carried out, and at the present time the amount of work in hand is larger than at any previous period. Amongst the contracts at present in hand is one for the erection of electric lighting plant for public lighting in the streets of Johannesberg. The central station plant supplied by the company for Barcelona is working thoroughly satisfactorily.

Bradford Branch.—This portion of the business, from whence the installation work in Yorkshire is carried out, has given progressive results, and the supply of goods in the North is being now dealt with from that centre.

With regard to the department for testing and proving of new patents and inventions, to which your directors drew attention in their last report, and at the general meeting, as likely to add materially to the profits, a large amount of business has been offered and examined. Out of the four important electrical inventions undergoing process of testing, mentioned in the previous report, only one has turned out sufficiently well to justify this company in introducing it to the public, this being the Epstein accumulator, to acquire and develop which the Epstein Electric Accumulator Company, Limited, has been formed, with Mr. Epstein as managing director, and from which this company looks for important pecuniary results.

Out of other new business in course of investigation by your officials, one, after close examination by your managing director, has turned out satisfactorily, and gives promise, on its introduction by your company at an early date, to command great attention.

The directors feel themselves justified in alluding to the various Elmore Copper Depositing Companies that have been introduced to the public under the auspices of your company. As the technical statements made have been proved by actual results, your directors not only believe that the several companies will fulfil the expectations held out by us, but will exceed them, and they have therefore entertained proposals for a further development of the process in other countries at an early date.

The sum of £75,000, lodged by Woodhouse and Rawson, Limited, with this company as guarantee fund for the payment of a minimum dividend of 15 per cent. per annum up to the 30th June next, has been repaid that company under the authorisation given to that effect at the last general meeting.

Under the articles, two directors retire, Mr. Samuel Pope, Q.C., and Mr. Phillip Rawson, who being eligible offer themselves for re-election.

The auditors, Messrs. Pixley & Co. (now Messrs. Jackson, Pixley, Husey & Co.), retire according to the articles, and offer themselves for re-election.

BALANCE SHEET, *July 31st*, 1891.

	£	s.	d.
Share capital authorised—			
60,000 ordinary shares of £5 each	300,000	0	0
50,000 preference shares of £5 each	250,000	0	0
	£550,000	0	0
Share capital issued—			
Ordinary shares of £5 each:			
34,355—£2 10s. called up	85,887	10	0
15,531—fully paid	77,655	0	0
Preference shares of £5 each—			
37,053 fully paid	185,265	0	0
6 per cent. mortgage debentures of £100 each—			
fully paid	65,500	0	0
5½ per cent. debenture stock	85,192	0	0
Mortgages on freehold property	23,500	0	0
Sundry creditors, 31st May	40,544	4	9
Reserve fund	25,000	0	0
Pension fund	1,065	0	0
Profit, as per profit and loss account, £51,439 4s. 5d. less interim dividend paid, £14,464 16s.	36,974	8	5
	£626,583	3	2

	£	s.	d.
Freehold premises, West Kensington Hall, London, and Union Foundry, near Crewe, less depreciation	65,131	9	6
Leasehold premises at 88, Queen Victoria Street, 34, Cannon Street, Cornbrook Telegraph Works, Manchester; Bradford, and expenditure theron ...	3,316	14	7
Plant, machinery and tools at London, Manchester, Kidsgrove and Chiswick Works, and at Bradford, less depreciation	31,392	12	2
Stock (finished and unfinished) and merchandise at works, depôts, warehouses and branches, by valuation	93,704	17	10
Goods in transit	895	1	7
Expenditure on contracts in hand and remittances to branches	31,466	13	4
Moiety special expenditure on advertising, repayable by instalments	3,425	0	0
Patents, patent rights, &c.	76,328	0	0
Goodwill	98,080	3	5
Sundry debtors, May 31st	91,059	0	10
Due on calls	605	10	0
Bills receivable	4,432	15	2
Cash—			
At bankers and in hand, May 31st	5,516	13	8
Difference between receipts and payments, June 1st to July 31st	472	11	8
Sundry investments	119,338	15	0
Office furniture, fittings, &c.	1,417	4	5
	£626,583	3	2

PROFIT AND LOSS ACCOUNT for the year ending July 31st, 1891.

	£	s.	d.
Salaries	15,208	8	8
Postages and parcels post	979	7	5
Stationery, printing and catalogues	1,138	19	1
Travelling expenses	1,367	13	7
Rents, rates, insurance, &c.	2,993	16	1
Advertising and exhibition expenses	4,476	0	10
Legal and professional charges	1,921	8	2
Royalties and patent fees	2,467	7	9
Directors' fees	2,166	13	4
Furniture and fixtures depreciation account	354	13	2
Debenture interest from dates of payment to July 31st, 1891	7,366	13	9
Written off patents, patent rights account	4,156	19	9
Income tax for 1890 and 1891	3,182	16	6
Mortgage debentures redemption account	1,030	0	0
Preliminary expenses	3,260	8	10
Cadby Hall removal	2,000	0	0
Profit carried to balance sheet	51,439	4	5
	£105,510	11	4

	£	s.	d.
Brought forward from previous year	16,335	15	3
Gross profit	74,568	14	0
Balance of interest on loans and investments... ...	8,262	5	6
Balance of discount account	913	12	5
Rent	1,497	1	8
Premium on shares, transfer fees, &c.	3,933	2	6
	£105,510	11	4

We have examined the above accounts, with the books and vouchers of the company, and certify the same to be in accordance therewith. The amounts taken credit for, for plant, stock and works in progress, and investments not quoted, have been certified by the company's officials.

JACKSON, PIXLEY, BROWNING, HUSEY & Co.,
Auditors.

58, Coleman Street, London, E.C.,
November 4th, 1891.

PROPOSED APPROPRIATION ACCOUNT.

	£	s.	d.
Interim dividend already paid for the first half-year at the rate of 8 per cent. per annum on the preference shares and 15 per cent. per annum on the ordinary shares	14,464	16	0
Proposed dividend for the second half-year at the rate of 8 per cent. per annum on the preference shares, and 15 per cent. per annum on the ordinary shares	16,043	0	0
To reserve fund	10,000	0	0
„ bad debt reserve	1,500	0	0
„ *employés* pension fund	500	0	0
Carried forward to new profit and loss account ...	8,931	8	5
	£51,439	4	5
Net profit as per profit and loss account	£51,439	4	5

The West India and Panama Telegraph Company, Limited.

THE directors' report for the half-year ended June 30th, 1891, states that the amount to credit of revenue is £47,641 16s. against £52,351 2s. 4d. for the corresponding half-year of 1890, and the expenses have been £24,868 16s. against £26,669 17s. 4d. for the same period in 1890, leaving a balance of £22,773, which, with the balance of £668 3s. 2d. brought from last account, makes a total of £23,441 3s. 2d. Of this sum the directors have placed £2,000 to reserve, leaving an available balance of £21,441 3s. 2d., with which it is proposed to deal as follows:—

	£	s.	d.
First preference shares—			
Dividend, 6 months to June 30th, 6s. per share	10,368	18	0
Second preference shares—			
Dividend, 6 months to June 30th, 6s. per share	1,400	14	0
Ordinary shares—			
1s. per share (free of income tax) ...	4,416	1	0
Balance to current half-year's account ...	5,255	10	2
	£21,441	3	2

The traffic receipts for the six months show a decrease of £4,598 2s. 3d. as compared with the corresponding period.

The expenses for repairs to cables amount to £11,936 14s. 2d., being £1,999 14s. 1d. less than those for the corresponding half-year, owing to fewer interruptions.

The shareholders have been informed from time to time of the impending competition of the Société Française des Télégraphes Sous-marins. This competition assumed an active shape in the early part of June, when that company's cable was extended from Porto Plata (San Domingo) to the two French colonies, Martinique and Guadeloupe.

The rates to and from Martinique and Guadeloupe were reduced by the French Company, and the West India Company also found it expedient to reduce its tariff to the more distant colonies, where, owing to geographical position, the tariff is necessarily higher than in the more northern islands.

These reductions have entailed considerable losses of revenue, and owing to the marked depression of West India trade during the past few months, there has been not only no increase in the volume of traffic consequent upon the reduced rates, but an absolute falling off in the number of words transmitted. It is, however, anticipated that this trade will revive next year, as the prospects of the coming sugar crop are encouraging.

In view of the circumstances stated above, and of the large expenditure in repairs during the current half-year, the directors have deemed it prudent to carry over a larger balance than usual to the next account.

The company's ss. *Grappler* is now engaged in laying the new cable between Trinidad and Demerara.

A contract has been entered into with W. T. Henley's Telegraph Works Company for the manufacture and shipment of 250 nautical miles of deep-sea cable for stock.

The Swan United Electric Light Company, Limited.

—The directors of this Company have resolved to recommend the shareholders to declare a dividend at the rate of six per cent. per annum for the six months ending 30th September last, and of five per cent. for the twelve months ending at the same date, making, together with the interim dividend declared in May last, a total dividend for the year of eleven per cent.

TRAFFIC RECEIPTS.

The City and South London Railway Company. Traffic receipts for the week ended November 8th, amounted to £783.

The West India and Panama Telegraph Company. The receipts of the West India and Panama Telegraph Company for the two weeks ended October 31st, show a decrease of £951 as compared with the corresponding period.

The West Coast of America Telegraph Company, Limited. Traffic receipts fo the month ending October 31st, 1891, were £3,000.

SHARE LIST OF ELECTRICAL COMPANIES.

Present Amount Issued.	Name.	Stock or Share.	Closing Quotation. (Nov. 5th.)	Closing Quotation. (Nov. 12th.)	Business done during week ending (Nov. 12th, 1891.) Highest.	Lowest.
250,000£	African Direct Telegraph, Ltd., 4 p. c., Deb. Regd. and to Bearer	100	100 —103	100 —103	...	...
1,300,980£	Anglo-American Telegraph, Limited	Stock	49 — 50	48½— 49½	49½	48¾
2,849,510£	Do. do. 6 p. c. Preferred	Stock	87 — 88	86 — 87	87½	86½
2,849,510£	Do. do. Deferred	Stock	12⅝— 13¼	12¼— 12⅝	12⅝	12¼
130,000	Brazilian Submarine Telegraph, Limited	10	10⅝— 11¼	10½— 11	10⅞	10½
53,200£	Do. do. 5 p. c. Bonds	100	100 —103	100 —103	...	...
75,000£	Do. do. 5 p. c., 2nd Series, repayable in June, 1906 ...	100	103 —107	103 —107	...	...
77,978£	Brush Electrical Engineering Ordinary, Nos. 1 to 63,416	3	3⅜— 3⅝	3⅜— 3⅝	3 5/16	3 5/16
69,996£	Do. do. Non cum. 6 p. c. Preference, Nos. 1 to 63,416	2	2⅛— 2⅜	2⅛— 2⅜	2⅜	2¼
50,000	City and South London Railway, Nos. 1 to 50,000	10	3 — 5	3 — 5	3¼	...
$7,716,000	Commercial Cable, Capital Stock	$100	135 —140	135 —140	139	136
224,850	Consolidated Telephone Construction and Maintenance, Limited ..	14/-	7/16— 9/16xd	7/16— 9/16	½	...
20,000	Crompton & Co., Ltd, 7 p. c. Preference Shares, Nos. 1 to 20,000	Stock	5 — 5½	5 — 5½	...	...
16,000	Cuba Telegraph, Limited	10	10 — 11	10 — 11	...	...
6,000	Do. do. 10 p. c. Preference	10	17 — 18	17 — 18	...	...
12,931	Direct Spanish Telegraph, Limited, ... (£4 only paid)	5	3¼— 3⅜	3 — 3¼	3½	...
6,000	Do. do. 10 p. c. Preference	5	9½— 10½	9½— 10½	...	...
60,710	Direct United States Cable, Limited, 1877	20	10⅜— 11⅛	10⅜— 11	10⅞	...
400,000	Eastern Telegraph, Limited, Nos. 1 to 400,000	10	14¼— 14½	14 — 14¼	14 5/16	14
70,000	Do. 6 p. c. Preference	10	15 — 15½	15 — 15½	15⅜	...
200,000£	Do. 5 p. c. Debs. (1879 issue), repay. August, 1899	100	107 —110	107 —110	...	...
1,200,000£	Do. 4 p. c. Mortgage Debenture Stock	Stock	106 — 109xd	106 — 109	107⅛	106
250,000	Eastern Extension, Australasia and China Telegraph, Limited ...	10	15⅛— 15⅜	14⅞— 15⅛	15¼	15
78,300£	Do. 5 p. c. (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	104 —107	103 —106	...	...
276,200£	Do. do. Bearer Nos. 1050—3,975 and 4,327—6,400 ...	100	104 —107	103 —106	...	...
320,000£	Do. 4 p. c. Debenture Stock	Stock	106 —109	106 —109	...	...
135,000£	Eastern and South African Telegraph, Ltd., 5 p. c. Mort. Deb. 1900 redeem. ann. drawings, Registered Nos. 1 to 2,343	100	102 —105	102 —105	...	...
180,400£	Do. do. do. to bearer, Nos. 2,344 to 5,500	...	102 —105	102 —105	...	...
201,600£	Do. do. 4 p. c. Mort. Debs. Nos. 1 to 2016, red. 1909	100	99 —102	99 —102	...	...
45,000	Electric Construction, Limited, Nos. 101 to 45,100	10	6½— 7	6⅝— 7⅛	7	6 13/16
19,900	*Electricity Supply Co. of Spain, Nos. 101 to 20,000	5	... ..	... ...	...	...
66,750	Elmore's French Patent Copper Depositing Co., Ltd, Nos. 1 to 66,750	2	2⅝— 2⅞	2⅝— 2⅝	2 9/16	2⅜
70,000	Elmore's Patent Copper Depositing, Limited., Nos. 1 to 70,000 ...	2	3¼— 3½	3 — 3¼	3⅛	2⅞
67,385	Elmore's Wire Mfg., Ltd., Nos. 1 to 67,385, issued at 1 p.m., all pd.	2	1½— 1⅝	1⅝— 1⅞	1⅞	1¾
20,000	Fowler-Waring Cables, Nos. 301 to 20,300 ... (£4 10s. only paid)	5	2 — 3	2 — 3	...	...
180,227	Globe Telegraph and Trust, Limited	10	9⅜— 10	9⅝— 9⅞	10	9⅜
180,042	Do. do. 6 p. c. Preference	10	14⅜— 15	14⅜— 15	14⅞	14⅜
150,000	Great Northern Tel. Company of Copenhagen	10	18¾— 19¼	18¼— 18⅜	18⅝	...
220,000£	Do. do. 5 p. c. Debs. (issue of 1883) ...	100	105 —108	105 —108	107½	...
12,134£	Greenwood and Batley, Ltd., Ordinary, Nos. 466/ to 14,000 ...	10	8 — 8½	8 — 8¼	...	...
9,600£	Do. 7 p. c. Cumulative Preference, Nos. 2,667 to 8,000	10	9½— 10½	9½— 10½	...	...
41,600	India-Rubber, Gutta Percha and Telegraph Works, Limited ...	10	20 — 21	20½— 21½	21⅜	20⅞
200,000£	Do. do. 4½ p. c., Deb., 1896	100	102 —104	102 —104	...	...
17,000	Indo-European Telegraph, Limited	25	41 — 43 xd	41 — 43	42	41½
11,334	International Okonite, Ltd., Ordinary Nos. 22,667 to 34,000	10	6 — 7	6 — 7	...	...
11,334	Do. do. Preference Nos. 5,667 to 17,000 ...	10	8¾— 9½	8¾— 9¼	...	...
38,348	London Platino-Brazilian Telegraph, Limited	10	6½— 7½	6 — 7xd	...	...
100,000£	Do. do. do. 6 p. c. Debentures	100	105 —108	105 —108	...	...
43,900	*Metropolitan Electric Supply, Ltd., Nos. 6,101 to 50,000 (£9 paid)	10	10 — 10½	10 — 10½	10 1/16	10¼
447,234£	National Telephone, Limited, Nos. 1. to 438,984	5	4¼— 4½	4⅜— 4⅝	4 9/16	4 7/16
15,000	Do. 6 p. c. Cum., 1st Preference	10	12½— 13	12½— 13	...	...
15,000	Do. 6. p. c. Cum. 2nd Preference	10	12 — 13	12 — 13	...	...
420,000£	Do. 4½ p.c. Deb. Stock Prov. Certs. fully paid ...	...	106 —108	106 —108	107⅝	107
6,318£	Notting Hill Electric Lighting Company, Limited, £8 paid ...	10	6 — 7	6 — 7	...	...
220,000£	Oriental Telephone, Ltd., Nos. 80,001 to 300,000 (11s. only paid)	1	3/16— 5/16	3/16— 5/16	...	...
9,000£	Reuter's Limited	8	7½— 8½	7½— 8½	...	...
18,680	St. James's & Pall Mall Electric Light Co., Ltd., Ord., 101—18,780	5	8½— 8¾	8¾— 9½	9	8 11/16
7,900	Do. do. do. 7 per cent. pref.	2	7¼— 7⅜	7¼— 7⅜	7⅝	7 9/16
3,381	Submarine Cables Trust	Cert.	118 —123	118 —123	...	...
78,949	Swan United Electric Light, Limited ... ... (£3½ only paid)	5	4⅜— 5⅛	4½— 5	5 1/16	4⅝
37,350	Telegraph Construction and Maintenance, Limited	12	42 — 44	42 — 44	43½	42⅜
150,000£	Do. do. do. 5 p. c. Bonds, red. 1894	100	102 —105	102 —105	103⅜	...
58,000	United River Plate Telephone, Limited	5	1 — 2	1 — 2	...	...
146,370£	Do. do. 5 p. c. Debenture Stock ...	Stock	85 — 95	85 — 95	...	...
3,200£	Do. do. 7 p. c. Debs., Nos. 1 to 1,000 ...	100	... ...	... ...	...	...
15,609	West African Telegraph, Limited, Nos. 7,501 to 23,109	10	7½— 8½	7½— 8½	...	...
271,400£	Do. do. do. 5 p. c. Debentures	100	98 —110	97 — 100	98	97
30,000	West Coast of America Telegraph, Limited	10	2 — 3	2 — 3	...	...
150,000£	Do. do. do. 8 p. c. Debs., repayable 1902 ...	100	98 — 103	97 —102	...	...
67,007£	Western and Brazilian Telegraph, Limited	15	10¼— 10⅝	10¼— 10⅜	10⅜	10⅜
30,364£	Do. do. do. 5 p. c. Cum. Preferred	7½	6½— 7	6½— 7	...	...
30,364£	Do. do. do. 5 p. c. Deferred	7½	4 — 4½	4 — 4½	4½	4¼
189,700£	Do. do. do. 6 p. c. Debentures "A," 1910 ...	100	104 —107	104 —107	...	...
237,200£	Do. 6 p. c. Mort. Debs., series "B" of '80, red. Feb., 1910	100	103 —106	103 —106	...	...
88,321	West India and Panama Telegraph, Limited	10	1½— 1⅝	1⅝— 1⅝	1⅝	1½
34,563	Do. do. do. 6 p. c. 1st Preference ...	10	8½— 9¼	8⅝— 9¼	9⅛	9
4,669	Do. do. do. 6 p. c. 2nd Preference ...	10	7½— 8½	7½— 8½	...	...
$1,336,000	Western Union of U.S. Tel., 7 p. c. 1st Mortgage (Building) Bonds	$1,000	118 —122 xd	118 —122	...	...
173,100£	Do. do. 6 p. c. Sterling Bonds	100	98 —102	98 —102	...	...
59,900	*Westminster Electric Supply Corp., Ord., Nos. 101 to 42,953 ...	5	6 — 6¼	6¼— 6⅜	6¼	6¼

* Subject to Founders' Shares.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Blackpool Electric Tramway Company, Limited, £10 (£6½ paid), 7¼—7⅜.—City of London Electric Lighting (Pioneer), Shares of £50, fully paid, 60—62.—Ordinary of £10 each, £4 paid, 4⅛—4⅜.—Electric and General Investment, Shares of £5, £1 paid, 1⅝—2¼.—Elmore's Austrian Copper Depositing, 15s., 25s., £2 share issued at 10s. prem. fully paid, 1—1¼.—Elmore's Priorities, 3¼—4¼.—European Sims-Edison Torpedo Company, shares of £20, £10 paid, 10—10½.—Halifax and Bermuda Cable, 4½ per cent. bonds, 85—95.—House to House Company (£5 paid) 4½—5.—Liverpool Electric Supply, Shares of £5, £3 paid, 2⅜—2⅞. Shares of £5 (fully paid), 4⅞—5⅛.—London Electric Supply Corporation, Ordinary (£5 paid), 1⅛—2⅛.—Manchester, Edison and Swan Company, £9 (£1 paid), ⅛—⅜.—National Telephone Debentures, 2⅛—3 prem.—Woodhouse and Rawson Ordinary of £5 (£2 10s. paid), 2⅛—2⅜.—£5 Preference, fully paid 3¾—4.—Debentures, 90—95.—Wards Electric Car, £10 paid, ¾—1.

BANK RATE OF DISCOUNT.—4 per cent. (October 29th, 1891).

THE OLD ELECTRO-CHEMICAL THEORY AND THE NEW DISSOCIATION THEORY AT ISSUE.

In our issue for August 21st, p. 220, we had a short article based on some recent work of Prof. W. Ostwald, in which the question whether galvanic currents can be developed in aqueous solutions without the help of any metal was considered. The question occurred in a paper by the Professor, dated from the University Laboratory of Physical Chemistry, Leipsic, entitled "Chemical Action at a Distance." This paper, which was printed in the August number of the *Philosophical Magazine*, was in many respects a remarkable one, and it has occasioned a strong protest from Mr. S. U. Pickering, F.R.S., in the current issue of this magazine.

Prof. Ostwald was contending in his paper in favour of the "Theory of Free Ions," and he described some experiments for which, in his opinion, "a satisfying explanation can be first gained on the ground of the theory of free ions," and which, having been "worked out at [his] writing table before [he] had seen anything of the phenomena in question . . . . . speak," he considers, "more forcibly than any polemics for the value of this theory."

Mr. Pickering now endeavours to elicit some explanation as to what the difficulty is in explaining, or even predicting, the facts on the old theory of electro-chemical action, and why they are to be regarded as affording any proof of the dissociation theory, and since we have been reporting both sides of the controversy which has arisen over the new theory, we shall quote Mr. Pickering—who is one of its stoutest opponents—pretty fully.

It would be as well for any of our readers who are interested, to consult Prof. Ostwald's article on "Chemical Action at a Distance," in the August number of the *Phil. Mag.*, p. 145, where they will find the experiments all described at length, with the Professor's interpretation of them.

Mr. Pickering selects the chief experiment which was as follows :—A zinc platinum couple is placed in a solution of potassium sulphate, and on adding sulphuric acid to the liquid near the platinum, the acid is decomposed with liberation of hydrogen, while the zinc goes into solution, whereas, when the acid is added to the liquid near the zinc, no action occurs.

Now Mr. Pickering argues that the explanation of such a result appears to be perfectly simple, without calling in the aid of the dissociation hypothesis. We have only to remember that a zinc-platinum couple will not decompose potassium sulphate, but will decompose sulphuric acid, and that these effects will in all probability remain unaffected by the slight modification of the ordinary contacts obtaining in Prof. Ostwald's experiment ; also that in all salt-solutions there is a continual interchange going on between the ions in contiguous molecules, which interchange involves no expenditure of work. That being so, the action will be represented by the following scheme :—

$$\overset{+}{Zn}\ SO_4 \vdots K_2\ SO_4 \vdots K_2\ SO_4 \vdots H_2\ \overset{-}{Pt}.$$

No work, or only an infinitesimal amount, is done in transferring the K_2 from one SO_4 to the next ; no potassium sulphate is really decomposed, for there are as many molecules of it present after as there were before the re-action ; and the only body which is decomposed is the acid, a decomposition which we know a zinc-platinum couple will effect.

The following scheme shows that if the acid is placed in contact with the zinc, no decomposition could occur unless the couple were capable of decomposing the potassium sulplate, which it is not :—

$$\overset{+}{Zn}\ SO_4 \vdots H_2\ SO_4 \vdots K_2\ SO_4 \vdots K_2\ \overset{-}{Pt}.$$

Such an explanation appears to Mr. Pickering to be much more simple than one which involves the idea that neutral zinc, when placed in a neutral solution, shoots off the positive ions, leaving the remaining portion of the metal negative ; the electric charges which convert the atoms into ions, consisting of a something, and the charging being accomplished in a manner of which, as Prof. Ostwald admits on p. 148 of the *Philosophical Magazine* for August, no explanation can be given.

Prof. Ostwald has quoted other experiments which, in Mr. Pickering's opinion, seem no less inconclusive than the above in favour of the dissociation theory. The slow dissolution of copper in weak oxygenated sulphuric acid would seem to be explained at least as well, he thinks, on this view, that the copper is first oxidised, and that the oxide of copper then dissolves (copper oxide, but not metallic copper, being capable of doing so with evolution of heat), as on the view that the hydrogen ions of the acid are oxidised and thus give place for the copper ions shot off from the metal. The dissolution of gold in chlorine water obviously requires no recourse to the free ion theory for an explanation ; nor does the following experiment, which practically closes the list of Prof. Ostwald's "proofs," and which we quoted in our article on August 21st.

A beaker containing ferrous chloride solution is connected by means of a siphon containing sodium chloride solution, with another beaker containing chlorine solution ; on inserting connected platinum plates into the beakers a current passes, and the ferrous chloride becomes chlorinated to ferric chloride. Here the platinum in the one beaker is slightly acted upon by the chlorine, and therefore becomes electro-positive towards the platinum in the beaker with the ferrous chloride ; the latter platinum consequently becomes electro-negative, the iron atoms in its proximity become more than usually electro-positive, being thereby rendered capable of attaching to themselves more chlorine, according to the following scheme.

	$Fe\ \overset{Cl}{Cl}$	Cl	Fe Cl	Cl	Fe Cl	Cl	Na	Cl	Na	Cl	Cl		
− Pt													+ Pt
	$Fe\ \overset{Cl}{Cl}$	Cl	Fe Cl	Cl	Fe Cl	Cl	Na	Cl	Na	Cl	Cl		

It is perhaps, says Mr. Pickering, more propable that the chlorine atoms which the sodium atoms on the extreme right combine with, are derived, not directly from the chlorine molecules as represented in this scheme, but from molecules of hydrochloric acid or platinum chloride present in the liquid. The chlorination of the ferrous chloride naturally occurs with those molecules which are nearest to the negative platinum, as Professor Ostwald observes is the case. It is difficult to see why such an experiment should be regarded as a proof of the dissociation theory.

All these experiments are stated to be on a par with one described some years ago by Prof. Ostwald, consisting in the production of a small amount of electrolysis by a current of electro-static origin, experiments which Mr. Pickering considers are perfectly consistent with the old electro-chemical theory, dressed up in the garb of the dissociation theory, and then presented to us as a proof positive of this theory.

We shall be interested to see Professor Ostwald's rejoinder.

ELECTRICITY IN THE MEASUREMENT OF TEMPERATURE.

An investigation of the colour changes which pigments undergo when subjected to wide ranges of temperature, has recently been undertaken by Messrs. E. L. Nichols and B. W. Snow, and they have succeeded in obtaining a number of exceedingly interesting results. There is one feature in their plan of experiment which is worth a brief notice in these pages. It was a consideration of great importance as to the best method of measuring the temperature, and finally it was decided that the following method, involving the use of electricity, presented the fewest objections :—

A thin layer of the pigment was supported upon a ribbon of platinum foil, which could be maintained at any desired temperature by means of an electric current ; the linear expansion of the foil could then be measured. The strip was 25 cm. long and 7 mm. wide. It was placed in the circuit of a Gramme dynamo and heated to a cherry red, brass rods being soldered to the ends of this platinum strip, capable of carrying a heavy current without heating. These passed through the arms of a frame in which the strip was mounted, and one of them bore a compressed spiral spring which served to keep the ribbon properly stretched. By means of a dividing engine two fine diamond rulings, 89 mm. apart, were drawn upon the foil at right angles to its length. Two microscopes, each provided with a micrometer eye-piece reading

0·0025 mm., were now focussed upon these lines, so that when the strip expanded longitudinally under the heating action of the current, the increment could be readily and accurately measured.

In computing the temperature from this platinum foil "thermometer," Matthiessen's well-known formula was used, in which the length of a platinum wire is expressed as a function of its temperature, thus—

$$l = l_0 (1 + 0{\cdot}00000851\, t + 0{\cdot}0000000035\, t^2).$$

This formula is only strictly applicable within the range 0°—100° Centigrade.

LEGAL.

Action against Electrical Engineers.—In the Court of Session, Edinburgh, before Lord Kyllachy, evidence was commenced on Wednesday, and extended over Friday of last week, in an action brought by John Denby, stereotyper and electrotyper, 4, Swinton Row, Edinburgh, against Ernest Scott and Mountain, Limited, engineers, Close Works, Newcastle-upon-Tyne, for £500 damages for alleged breach of contract. The pursuer states that up till the end of the year 1890, or the beginning of 1891, the defenders' business was carried on under the name of Ernest Scott & Co., and thereafter under the name of Ernest Scott and Mountain. Ernest Scott & Co. had exhibits of their electrical manufactures, and in particular of dynamo machines, at the Edinburgh Exhibition of 1890. In June of that year the pursuer purchased a dynamo for the specified and particular purpose of being used in his business as an electrotyper. It was delivered about the middle of September, and was properly fitted up, but pursuer avers that it turned out unfit for the particular purpose for which it was furnished, in respect that—(1) it was constructed both for the purpose of nickel-plating and electrotyping—a dynamo constructed for nickel-plating not being suited for electrotyping; (2) the dynamo was much too powerful for electrotyping, and caused the deposit of copper to take a granular form instead of presenting a smooth, tough surface; and (3) it could not produce an electrotype sooner than twelve or fourteen hours, whereas it should produce one within from three to five hours, according to the quantity of moulds in the bath. The purchase price of the machine was £55, and the pursuer states that through its breakdown he was unable to execute a large order, and that his business suffered in other respects on account of the bad work it produced. The defenders deny that they entered into any contract with the pursuer. They explain that at the end of December, 1890, they purchased the business carried on at Close Works by Ernest Scott & Co., and are now carrying on the same. The machine, they say, was not supplied by their predecessors for any particular purpose, nor did the defenders assume any responsibility or liability in respect of any contract entered into with the pursuer. The defects in the dynamo are said to have been due to insufficient fitting up, lack of knowledge on the part of the pursuer, want of skill in manipulation, and to the absence of necessary instruments.

JOHN DENBY, who was the first witness, said he was the pursuer in this case. He was an electrotyper and stereotyper, and had been in business for nearly seven years. In May, 1890, he desired to have a dynamo machine for his electrotyping. He saw one at the stand of Ernest Scott & Co., at the Edinburgh Exhibition. He examined it so far as he could see it. It was under the charge of Mr. Lowes, the representative of Scott & Co. He told Mr. Lowes he wanted a machine for electrotyping, and asked him if he had been in the habit of supplying those machines for such a purpose, and he said yes. The firm communicated with witness, Mr. Lowes having communicated with them. Witness got a catalogue from them, and found in it the size of the machine which he thought would be suitable for his work. It was a £50 machine—a No. 3 depositing machine. The defenders did not supply me with a No. 3, but with a No. 5, recommended by them, at the price of £55. He mentioned to them the way in which he proposed to drive it. On August 6th he communicated to them by letter the dimensions of the flywheel of his gas engine, and the number of revolutions per minute. He ordered a gas engine for the purpose of driving the dynamo. The defenders undertook to give a driving pulley appropriate to drive the dynamo. The machine was delivered in the end of August. He connected it with the gas engine and commenced to work with it. The result was, that in consequence of what he considered the high pressure of voltage the deposit was spongy. There was an appearance of decomposition in the water of the bath that was unusual, indicated by the water boiling and bubbling round the cathode. Witness communicated with Mr. Lowes, who came to see the machine, and he let him see its working. Mr. Lowes showed him how to set the brushes, but the results were as bad as before. The machine in that condition was not fit to do electrotyping at all. He continued to work the machine for some time. He was not successful. He found that the deposit of copper on the plate was granulated. A good copper shell should be tough, malleable, and as smooth as they wanted for their purpose. When it was granulated it broke away in pieces, and was very unsuitable for electrotyping. He asked Mr. Lowes to come back again, which he did, and witness let him see the machine working. Mr. Lowes saw the bad product it was making. Mr. Lowes said he knew nothing at all about it. He did not do anything then to regulate the machine. Later on, as the result of witness asking him to do something for it, the defenders sent him instructions to the effect that he was to be shown how to work the machine effectually, and he came and adjusted to the machine an ampère-meter, a voltmeter, and a resistance coil. There was then an improvement. Throughout this period witness communicated with the defenders complaining of the machine, and they said he did not know how to work it. In December he went up to Newcastle and explained to the defenders the difficulties he had with the machine, and the effects produced on his plates by using it. He took specimens of what was produced by the dynamo. The defenders made several suggestions. He carried out these suggestions, but the results were just as bad as ever. About the end of January last or the beginning of February, Mr. Rolfe, the defenders' manager, came to see the machine, after witness had given up all thought of having any more trouble with it. Witness spent a great part of his time over the machine. He altered the proportions of the constituent elements in the bath several times—with sometimes better results than at other times, but never satisfactory. He did not find he could get a good deposit by any change he made. The defenders admitted at Newcastle that the plates he showed them were imperfect. Mr. Lowes came back in February to try the machine. He put four moulds into the bath. He stopped the whole day and watched the machine carefully, but did not succeed in producing a good result. For the quantity of work put by witness into the bath less than five hours should have produced a good deposit. The dynamo usually took about eleven hours to produce deposits. When working with the battery before he got the dynamo, his custom was to start the battery at night and take the shells out in the morning, which allowed eleven or twelve hours. The advantages of the dynamo over the battery were its speed, convenience, and cheapness. It was less liable to go wrong. With a good dynamo good work could be produced much cheaper than by the battery. Mr. Lowes did not on any of his visits complain about the constituent elements in the bath. He made no complaint to witness about the mode in which he was working the machine. Mr. Lowes saw everything. Witness put him in full control of the machine and bath when he was there, and on the last occasion witness told him that as his firm accused witness of placing obstacles in the way of the success of the machine, he placed him in control of the hands and material. The defenders never suggested to him that the dimensions of the dynamo pulley were wrong. Witness was constantly experimenting with the bath to try and bring it up to what was wanted of the machine, because he explained to the defenders that the bath should be treated in the same way as the machine in the way of finding out whether the constituents were right or not. He had estimated the amount of loss that had been occasioned to him by the breach of contract on the part of the defenders. He had an order from Newcastle to furnish electrotypes for 16 volumes of novels. The order fell through, as witness was not able to complete the work in time. Witness also detailed a number of other orders he had lost. He also produced gas and water accounts, and estimated loss of material at £15, and loss of his own time in attending to the bath at £33. During the months from September till February he did nothing but attend to the machine. The failure to perform his work during that time injured his business very seriously by customers dropping off. His business had been virtually ruined. He estimated his loss of business at £200. The dynamo was ultimately taken away by the defenders, and he had not paid for it. He fitted up a gas engine expressly to work the machine. The price was £105, and fitting up cost £5 or £6. The shafting put up for the other purposes of the machinery cost £44.

In cross-examination, witness said that before he got this machine he had never worked, or had anything to do with the working, of a dynamo for electrotyping. He had done his electrotyping solely by battery. No. 3 of class 5 on the defenders' catalogue was the article he ordered. He observed at the top of the catalogue: "These dynamos are for refining and depositing gold, copper, tin, and other metals." It was no part of his process to refine the metal. He wanted a machine merely for depositing. The defenders' intimation that they were putting in hand for him a No. 5 plating dynamo was to his entire satisfaction. After the dynamo came he had nobody to teach him how to work it. He did not think it required that. He had been accustomed to a bath for plating with a battery, and when he got the dynamo he commenced by making his solution denser with sulphate of copper. There was skill necessary in the composition and arrangement of the contents of the bath. The work might also be good or bad, according as the plates were placed in the bath, and according to the distances they were placed from each other. Witness believed the bad work he got was produced with the dynamo working 2,000 revolutions per minute. Mr. Lowes never told him he suspected the bath was wrong. He told him that the bath was too small. He did not give him a formula of the solution. When Mr. Lowes tried his hand at it, he did so without knowing what was in the bath or not. Witness manipulated the bath for him. Previous to Mr. Lowes coming to try the machine, the defenders wrote that they had constructed the machine with a power of six volts, which, if he had known it at first, he would have told them at once was too high. He could not tell what the voltage was when Mr. Lowes tried it. The faults witness found with the plates were that it took too long to get them, and the deposit was not thick enough. The density of the bath would not have anything to do with the thickness of the deposit or with the length of time taken to get the deposit. Shown a number of plates produced by the dynamo after it was taken away from the pursuer's shop, he admitted they were good plates, and said that a dynamo which produced them in two hours and fifty-eight minutes must be a good one. He was convinced from his experience that with any amount of skill on the part of the operator, the dynamo which was supplied to him would not produce such work. He considered the dynamo supplied to him was bad, because it could not do both nickel-plating and electrotyping. He was under the impression that the voltage was too high for electrotyping.

ERNEST ALBERT BROWNING, Superintendent in Edinburgh for the Brush Electrical Engineering Company, said he was thoroughly conversant with dynamos of the construction of the one now in question. He inspected the dynamo supplied by the defenders to the pursuer, and formed the opinion that as it stood it was not suitable for electrotyping, because it had not been constructed for electrotyping alone, but for nickel-plating also. It had in consequence too high electromotive force, and the result of that was that altogether too great a current was got through the bath, which destroyed the copper. From an electrical point of view, the machine was quite properly fitted up. He had seen some plates which had been in the bath for an hour and a-half or two hours. There was just a fringe of copper round the edge of the mould. There ought to have been a certain deposit in that time. It was not a good deposit. It should take from three to five hours to procure a suitable coating for electrotyping. A battery took from ten to twelve hours, as a rule. The dynamo in question was a very simple one to work. The preparation of the moulds and the bath for the battery was also what was required for the dynamo. Electrotypers usually tested their solution in the bath by testing it for the strength of the acid. That was the important question to determine. He saw nothing in the way pursuer was working his bath, or in the way in which it was connected to the dynamo, that suggested to his mind that the pursuer was doing wrong. He had no suggestion to make if the dynamo had been of its proper voltage or electromotive force or strength of current. There was too much electromotive force. Witness saw the resistance coil that had been supplied to the pursuer. He did not think it sufficient to reduce the electromotive force to the proper density for electrotyping. From his own experience, he should have put in a considerably heavier resistance. On October 28th last, he saw the dynamo in question at the works of Mr. Goskirk, Norton Park, Edinburgh. It was not working. He was informed that satisfactory results had been produced by it. If that were so, there might have been two reasons for it—either that they had introduced resistances, or that they had reduced the speed of the machine. He calculated from the size of the pulleys on the engine at Goskirk's works, and the intermediate shafting, that the dynamo must be worked at 750 to 800 revolutions. That, he considered, would produce a current suitable for electrotyping. From the size of the flywheel of the pursuer's gas engine and of the pulley, he calculated that the dynamo when at the pursuer's shop must have revolved at the rate of 1,200 per minute. That dynamo as he saw it would not give a suitable coating of copper. Asked if the driving pulley was appropriate if the dynamo was to be connected with an engine the flywheel of which was four feet in diameter and the revolutions 160 per minute, the witness replied, yes, if they wanted to run the dynamo at 1,200 revolutions, but if they wanted to deposit copper with it the dynamo would have to be reconstructed to run at that speed, or else the pulley would have to be enlarged.

In the cross-examination witness said he was not an electrotyper. He was afraid there would be a difficulty in an electrotyper regulating and controlling the current so as to get good work at 1,200 revolutions, because the bath would require to be so abnormally large, as the resistance would be very great. The plates would require to be a great distance apart. It was a question of resistance. He could not say that he was the inventor of the objection to the dynamo, so far as it was founded on the size of the pulley. The pursuer consulted him as a man of skill with reference to this case. The speed of the dynamo depended on the comparative diameters of the pulley of the dynamo and the flywheel of the engine.

JOHNSTON STEVEN, electrical engineer, Edinburgh, said he was well acquainted with the construction of dynamos such as they were concerned with here. He saw the dynamo in question at the pursuer's place of business on February 8th last. He considered it might be a suitable dynamo for electrotyping work. Driven at 1,120 revolutions per minute it would not be suitable for electrotyping, as he was told six volts were developed. In depositing copper they must not have an electromotive force so high as that. He did not think the gas engine could drive the dynamo properly if driven at half speed, because the gas engine going at slow speed would not drive the dynamo regularly—it would be fitful in its action. The resistance coil used was not sufficient. A dynamo ought to produce a coating of copper in from three to five hours. On October 28th he saw the dynamo at Goskirk's works. The plates produced there seemed to be satisfactory. If the dynamo had been driven at 750 to 800 revolutions per minute the electromotive force developed would have been considerably less, and he should expect it would produce the plates he saw.

Cross-examined: He had not calculated it, but he should say that the highest number of revolutions at which this dynamo would produce work as good as he saw at Goskirk's was from 700 to 800. He never saw the dynamo at work on any occasion. He was told the dimensions of the flywheel, the pulleys, and the dynamo, and calculated the speed. The electromotive force of any given dynamo could be diminished by altering the winding of the armature or increasing the resistance within the shunt.

(To be continued.)

Cadogan Electric Light Company, Limited.—On Saturday Mr. Warmington, Q.C., on behalf of Mr. H. Lowenfeld, presented to Mr. Justice Kekewich a petition for winding up this company. There was, counsel said, a voluntary winding up, and the petitioner's case was that since February last, when this began, the company had been going on as before. The petitioner's affidavits showed that the voluntary liquidator had paid some of the creditors, and an order was asked for on the ground that he had no right to prefer any one creditor—he must pay them all equally. His answer was that he had given a personal guarantee to the bank, with the object, apparently, of carrying on the business, but as he (Mr. Warmington) read the Act this could not be done under a winding up.

Mr. VERNON SMITH, who appeared on a second petition, asked for compulsory order.

Mr. WAGGETT, for the company, submitted that no case was made out for supervision, much less for a compulsory order, which he strenuously opposed. He suggested that both petitions should stand over to see if the proposed sale could be carried out.

His LORDSHIP made a supervision order on Mr. Warmington's petition.

Latimer Clark, Muirhead and Company v. Colonel George Francis.—In the Queen's Bench Division last week, the case of Latimer Clark, Muirhead and Company, Limited, *v.* Colonel George Francis, was heard by Mr. Justice Grantham, sitting without a jury.

Mr. Lawson Walton, Q.C., and Mr. Gurdon were counsel for the plaintiffs, who are electrical engineers at Westminster; Mr. Whitehouse appeared for Colonel Francis.

Mr. GURDON explained that the action arose out of a claim with reference to the sub-division of founders' shares in the St. James's and Pall Mall Electric Lighting Company, Limited. That company was incorporated on March 2nd, 1888, and the plaintiffs and the defendant were joint founders of it. By an agreement dated April, 1888, and scheduled in the articles of association between the company on the one part and the founders on the other, it was provided the capital should be £100,000, divided into 19,980 ordinary shares of £5 each, and 100 founders' shares of £1 each. The founders guaranteed that 5,000 ordinary shares should be taken up by responsible persons by April 13th, 1888. For that the founders were to have allotted to them or their nominees 100 founders' shares in the company, and the founders agreed to make over 25 founders' shares, or one share to every person who should apply for 200 ordinary shares out of the first 5,000 allotted. The 5,000 shares were taken up or placed in due time, and the parties became entitled to the founders' shares. The only thing wanting was that they should send in a direction to allot the shares, as they should have agreed. There was some delay about this, but on the morning of July 13th the defendant appeared at the plaintiffs offices with a list made out of the persons to whom he proposed to have the shares allotted. It was at once objected to.

Mr. Justice GRANTHAM: I understood they were to be allotted as they respectively should desire.

Mr. GURDON: As the plaintiffs and the defendant desired. By this list more than twenty went to his nominees. The plaintiffs refused to sign it. Then the defendant said, "It must be signed to-day for Somerset House. If you will sign it I will afterwards adjust the shares, and put them right." That is the basis of the claim.

Mr. Justice GRANTHAM: You say the defendant refused to rectify it?

Mr. GURDON: Yes.

Mr. WHITEHOUSE: The defendant's case is that the shares were allotted by the company with the full knowledge of the plaintiffs; that everybody on the list was entitled to founders' shares, and it was assented to by the plaintiffs at the time.

Mr. Justice GRANTHAM: You say the list represents the agreement between you, and was signed without any reservation of any kind?

Mr. WHITEHOUSE: Yes.

Mr. GURDON proceeded to state that there was a counter-claim in respect to the disposition of the 25 shares in question and some preliminary expenses.

Mr. WHITEHOUSE remarked that the St. James's Company was now practically under the domination of Mr. Latimer Clark and his friends. Colonel Francis was a director, but had been voted out by the plaintiffs' contingent.

Mr. GURDON denied the accuracy of that statement.

Mr. WHITEHOUSE said the list was signed and agreed at the time. Afterwards Colonel Francis called on Mr. Latimer Clark because he had told him his partner was dissatisfied. Then Colonel Francis said if anyone else should turn up who was entitled to a founders' share then they would have to give him one, that was all. No one else had turned up, and the defendant was therefore under no liability.

Mr. Justice GRANTHAM pointed out that there was a letter which indicated a readjustment as contemplated. It might be the defendant did not mean anything of the kind.

Mr. FREDERICK WALKER, secretary of the St. James's Company, produced the books of the company.

Mr. Justice GRANTHAM said the plaintiff was a director of the company, and it was strange he could not get a look at his own books.

Another witness was called, and upon the completion of the plaintiff's case Mr. Justice Grantham held that no cause of action had been proved, and entered judgment for the defendant on the claim with costs.

Mr. WHITEHOUSE withdrew the counter-claim without prejudice to any further proceedings that might be necessary hereafter.

NEW PATENTS—1891.

18,421. "A new or improved electric lighting system." J. M. ORMES. (Communicated by S. L. Trippe, United States.) Dated October 26th.

18,423. "An improved telephone combination." Sir C. S. FORBES, Bart. Dated October 27th.

18,431. "Improvements in secondary batteries." M. WADDELL, J. B. ENTZ, and W. A. PHILLIPS. Dated October 27th. *(Complete.)*

18,432. "A portable electric illuminating advertisement." S. J. ROLLASON. Dated October 27th.

18,436. "Improved apparatus for measuring and recording electric currents." Sir W. THOMSON. Dated October 27th.

18,451. "Improvements in telephonic switching apparatus." A. R. BENNETT. Dated October 27th.

18,477. "A depolarising liquid for galvanic batteries." O. SCHLESINGER. Dated October 27th.

18,505. "A new or improved electric circuit controller or appliance." W. B. CLEVELAND. Dated October 27th.

18,510. "Improved electrical apparatus for indicating the time at which workmen's or other tickets or the like were placed therein." F. A. KOHL and C. POTTHOFF. Dated October 27th.

18,522. "Improved method of and apparatus for welding or working metals electrically." W. P. THOMPSON. (Communicated by C. L. Coffin, United States.) Dated October 27th. (*Complete.*)

18,524. "Improvements in insulators or insulating supports for electric conductors." W. P. THOMPSON. (Communicated by R. Hewitt and F. L. Pope, United States.) Dated October 27th.

18,534. "Improvements in electric telephonic instruments." A. MARR. Dated October 28th.

18,551. "Improvements in or relating to electrical terminals." C. J. HALL. Dated October 28th.

18,561. "An improved method of laying wires and cables in pipes or conduits." A. R. BENNETT. Dated October 28th.

18,595. "Improvements in electric meters." H. T. HARRISON and G. W. BUDD. Dated October 28th.

18,597. "Improvements in electrolysis." E. ANDREOLI. Dated October 28th. (*Complete.*)

18,626. "Improvements in the construction of electrodes for use in the electrolysis of solutions." J. C. RICHARDSON. Dated October 29th.

18,627. "Improvements relating to electrodes to be used in the electrolysis of solutions." J. C. RICHARDSON. Dated October 29th.

18,629. "Improvements in electric dynamos and motors." W. T. GARNETT. Dated October 29th.

18,641. "Improvements in electrical apparatus." B. F. KELLY. Dated October 29th. (*Complete.*)

18,646. "Improvements in electric motors and dynamo machines." H. CHITTY. Dated October 29th.

18,650. "Improvements in electrical switches." THE ELECTRICAL ACCESSORIES COMPANY, LIMITED. Dated October 29th.

18,653. "Improvements in means, electrically operated, for retarding and arresting the motion of trains, applicable also to tramcars." N. SHAGOURI and J. H. HALE. Dated October 29th.

18,714. "Improvements in the regulation of gas and oil engines for electric lighting purposes." F. E. GRIPPER and S. COYLE. Dated October 30th.

18,716. "Improvements in electricity meters." A. WRIGHT. Dated October 30th.

18,721. "Improvements in portable electric lamps or lights for domestic use and other purposes." J. DIXON. Dated October 30th.

18,723. "Improvements relating to resistance frames and the like used for electrical purposes." C. S. SNELL and WOODHOUSE & RAWSON UNITED, LIMITED. Dated October 30th.

18,726. "Improvements in the cores of electric coils." A. MARR and A. T. COLLIER. Dated October 30th.

18,733. "Improvements in and connected with electric telephonic apparatus." A. MARR and A. T. COLLIER. Dated October 30th.

18,771. "Improvements in electric railway brakes." H. PIEPER, Fils. Dated October 30th.

18,773. "Improvements in and relating to apparatus for the transmission and reproduction of sounds." T. J. HOWELL. Dated October 30th.

18,775. "Improvements in electric bell indicators." SIEMENS BROTHERS & CO., LIMITED, G. S. GRIMSTON, and E. PERRETT. Dated October 30th.

18,784. "Improvements in electrical measuring instruments, dynamo-electric machines, registering instruments, and transformer switches." J. SWINBURNE and W. FOX-BOURNE. Dated October 31st.

18,801 "Improvements in electric arc lamps." T. H. SMITH. Dated October 31st.

18,831. "Improvements in magnetic electric hair-pins, curling pins, and similar articles." G. COHEN. Dated October 31st.

18,834. "A novel application of electricity to domestic purposes." A. HOWLISON and W. J. NELSON. Dated October 31st.

18,837. "Improved means for supporting overhead electrical conductors round curves for electric railways or tramways." SIEMENS BROTHERS & CO., LIMITED. (Communicated by Siemens & Halske, Germany.) Dated October 31st.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1890.

10,359. "Improvements in connection with the electric lighting of ships and other places." T. W. WATSON and A. H. WATSON. Dated July 4th. 6d. Consists substantially in arranging two or more incandescent lamps in proximity together with one or more electro-magnets, in such a manner that the failure of one of the lamps will immediately and automatically light another in its stead, such automatic action being brought about by a series of contacts in connection with the electro-magnets, so arranged, that the failure of the incandescent lamp causes the energy of the electro-magnet to cease, and release a switch, which shunts the current into the branch circuit of another electro-magnet and incandescent lamp, which then lights. Should this, in its turn, fail, the action will be repeated as often as necessary. 4 claims.

12,151. "Method of and appliances for regulating at will the power and speed of an alternate current motor." SIEMENS BROS. AND CO., LTD. (Communicated from abroad by the firm of Siemens and Halske, of Berlin.) Dated August 2nd. 8d. Consists in varying the number of the active poles by varying the coupling of the motor bobbins. 2 claims.

14,155. "Improvements connected with switchboards for telephonic systems." H. T. O. FRASER and J. W. BROWN. Dated September 9th. 8d. The object of this invention is more particularly to accomplish multiple switching throughout several boards at a telephonic exchange, but is not limited thereto. 2 claims.

14,182. "Improvements in or connected with telephonic switching apparatus." H. T. O. FRASER and J. W. BROWN. Dated September 9th. 8d. The object of this invention is to provide, in connection with telephonic switching apparatus, means whereby whilst the annunciator is operated in the ordinary way when a call is made to the exchange, the annunciator does not fall when the operator at the exchange communicates with the distant station. 5 claims.

14,349. "An improvement in electric meters." SIEMENS BROS. AND CO., LTD. (Communicated from abroad by Messrs. Siemens and Halske, of Berlin.) Dated September 11th. 8d. Consists in employing, instead of a single rotatable solenoid, several of these of alternating polarity fixed on one axis, so that a magnet brought into their neighbourhood, attracting half and repelling half of them, has no effect on the position of the pointer which is fixed on the common axis of the solenoids. 2 claims.

14,433. "Improvements relating to coin-freed electrical apparatus." A. FORD-LLOYD. September 13th. 8d. Consists in disposing in any suitable position the effigy of a human being, animal, bird, fish, or the like, or a skeleton of either. Said figure, which is preferably jointed, is suspended directly or otherwise to the armature of the electro-magnet, so that when the electric circuit is closed the movement of the armature will transmit a corresponding motion to the figure. 3 claims.

14,686. "Improvements relating to the preparation or treatment of carbons for electric lamps or lighting apparatus." W. R. LAKE. (Communicated from abroad by Messrs. Lacombe & Co., Peret, near Paris.) Dated September 17th. 4d. The carbon is impregnated or saturated with, or has incorporated in it, either before or after the baking thereof, one or more substances, such as phosphoric acid and phosphate of ammonia. 2 claims.

15,250. "Improvements in and relating to the electric circuit connections used for lighting theatres or for analogous purposes." H. SOUTH. Dated September 26th. 8d. Relates to the electric circuit connections used for lighting theatres, or for similar purposes, whereby it is enabled to arrange lamps in groups and to control the same, in a convenient and efficient manner. 5 claims.

CORRESPONDENCE.

Telephoning of Great Cities.

My attention has been called to-day to a series of leading articles and letters, in your valuable paper, on the "Telephoning of Great Cities," and as this is a subject which has had an absorbing interest for me for the last ten years, I feel inclined to add my little say, and give your readers the history of the system which bears my name. I notice with extreme regret that personal feeling has been allowed to dull the edge of argument, and I trust that, acting upon the suggestion in the sensible letter of Mr. A. Erskine Muirhead, the discussion will be now carried on free from personalities and solely with the object of elucidating the best method of improving telephonic inter-communication.

No one will deny that the telephone service of great cities is bad, and that in Glasgow, Liverpool, Birmingham, London, or Paris, it is impracticable for a business man to attempt to hold two consecutive conversations to two different subscribers through his telephone. If he is fortunate to "get through" to the first subscriber without losing his patience, he will rarely if ever have time or patience left to carry him through the uncertain and tedious process of getting switched off again. In actual practice, in nine cases out of ten, the office boy, whose time is the least valuable, is sent to "ring up so-and-so, and come and fetch me when you get through to him."

As the subscribers become more numerous, the difficulties and delays increase.

Many systems have been tried to overcome these difficulties. The Law system failed everywhere, and had to be discarded;

the multiple switchboard made a decided advance, and Mr. Poole, of Manchester, added to it his ring-off, but still the great waste of time remains.

The system that bears my name was invented by me in Dundee in the spring of 1882. At that time I was sent there by the National Telephone Company as chief electrician. There were, as far as I remember, 13 subscribers, and as the rates were reduced in order to oppose a local company, we had quickly some hundreds of applicants for connections.

We took new premises, and I had to design and put into operation a switching system. I have to this day never seen the Law system in operation, and I had then no knowledge of it; I made drawings of my system, showed and explained to Mr. F. Faithful Begg, who was then the pioneer and moving spirit in Scotch telephoning, and sent them finally to the late W. F. Bottomley, who was then chief engineer to the National Telephone Company.

Mr. Bottomley wrote me on June 2nd, as follows:—

> The National Telephone Company, Limited,
> 11, Queen Victoria Street, London,
> *June 1st*, 1882.
>
> Dear Sir,—Many thanks for plan of your line system. I consider for busy circuits that it is the best arrangement that has up to now been suggested, notwithstanding the extra cost.
>
> When I come to Dundee, which will, I trust, not be long, I will pass my decided opinion as to its general adoption.
>
> Yours faithfully,
> (Signed) WM. FEREDAY BOTTOMLEY.
>
> J. J. Mann, Esq.,
> National Telephone Company,
> Dundee.

The system was adopted, with what success I must leave others to say. I left the National Telephone Company's service at the end of 1882, and the man who took my place, Lumley by name, immediately attempted to sweep away my system; he was prevented from doing so by the subscribers, who had had the advantage of comparing it with the indicator system of the local company. Lumley afterwards became a champion of my system, and told me many times how glad he was that he was prevented from changing it. Shortly after this Bennett, Miller, Somerville, and a host of others became its champion, and, as far as I can learn, no electrician, operator or subscriber, who has had a month's experience of it, has one word to say against it.

I had no patent for my system, and there was no influence to push it on, and extend it, and yet exchange after exchange has adopted it, although it is now, and has been throughout, opposed by the bulk of English telephonists.

Curious to say the objections raised to it to-day are the very same objections that were raised to it nine years ago, and yet everyone without exception who has practical experience of it finds that the objections only exist in imagination. The only question which remains unanswered by practical results is the question as to its success in large centres.

On this head telephonists divide themselves into two parties, first, those who have practical experience of my system, and who say it is just in large centres where its qualities are most needed and will produce the best results. Second, those who have no practical experience of it, and who assert that it will not do at all for large centres.

Which of these two parties is most likely to be right; those who have the experience or those who have not? Fortunately, any remaining doubt will soon be cleared up by the Mutual Telephone Company of Manchester, who have adopted my system, and whose exchange is increasing very rapidly, and will very shortly equal in size the National Telephone Company's. We shall then have my system and the acknowledged best multiple system in competition, and the subscribers will soon decide which is the better.

With regard to Bennett's B.A. paper, the only fault I find with it is that it is a little ahead of the times. That the result he aims at can be achieved by his method is scarcely a question of argument.

The comparisons of the number of motions gone through by the operators are matters of fact, being demonstrated continually and by a process of simple logical deduction; if, in my system of switching, some of the motions are discarded, and no new ones added, then my system must be quicker, and it will be easily understood that even if the saving of time for each connection were very small when multiplied by the thousands of connections made each day, it would quickly assume large proportions, but as a matter of fact the saving of time in making each connection in my system amounts in practice to *more than ⅔rds of the whole time taken to make the quickest connection on the American system.* Miller, of Dundee, has added an improvement by joining the ends of two of the circuit lines. It is a bright idea, and I congratulate him on it.

Goodwin does not know his subject well enough to argue with Bennett, and will, if he is wise, retire from the discussion before he is further discredited. All telephonists will see in his letters that he understands his subject merely as an organising telephone manager, not as an electrician, and though I cannot find language strong enough to condemn Bennett's invective, still I can sympathise with his irritation at being criticised by a man who makes such obvious misstatements. Bennett's friends and enemies are all bound to admit that he stands, at any rate, on a level with any English expert in telephone matters, and that he has earned his spurs, but I am bound to say the name of Goodwin is unknown to telephonists.

Goodwin says he found my system in India, called it the Law system, and discarded it. Now, the Law system necessitated a special instrument at the subscriber's end of the line, and this special instrument was made in large quantities and sent from America to England, and then to India and other countries. This instrument will not actuate my system. It was late in the autumn of 1882 when I firmly established my system in Dundee, and I made all the apparatus myself with the aid of a local carpenter and brass finisher. It was not until several years had elapsed that the indefatigable Bennett introduced modern and more perfect switches, and it was not until 1885 that the system began to be known outside Dundee. Yet Goodwin found it working in India in 1883. Now, if Goodwin still persists in attempting to hold this untenable position, I challenge it. If he will deposit £10 with you, Mr. Editor, I will do the same, and you may hand the loser's stake to the National Lifeboat Institution on satisfactory proofs of Goodwin's assertion being brought forward. I will go a step further, and for the sake of getting at the truth, my £10 shall be handed over to that institution on anybody proving that my system was adopted anywhere prior to its conception by me in Dundee in 1882.

Miller's interesting letter proves Bennett's case up to the hilt, and only shows that there is nothing very new about it, and that in some minor details he would add to it.

In your editorial note, October 16th, you say: "It is very desirable that our remarks of this subject should not be interpreted as antagonistic to the circuit wire system, which we know to be believed in by a minority with the fervency (with) which minorities will believe." I must take this to refer to my system, as no one at all believes in any other circuit system, but you should add in justice to this minority that it is made up of all those who have tried it.

You follow by asking why it has not been adopted. The answer is easy. It has been adopted wherever there has been no axe to grind. In the large centres it would necessitate taking out the old systems, which have been enormously expensive, and writing off large sums of capital. The existing telephone companies have never dared to face it. They have been putting off the evil day. It is a question for them to decide whether they will face the matter fairly and squarely now that it is almost too late, or drift on till their business is taken from them by the host of co-operative companies that are springing up, and whose recommendation is an efficient service.

I have only to add that at any rate my opinion is unbiassed by interested motives; I am not now connected in any way with telephone business. I have no wrongs to revenge or axes to grind, but I want to see a quick and reliable telephonic service, whether on my system or on a better, I care not, adopted in large centres.

J. J. Mann.

November 4th, 1891.

In p. 461, Mr. A. R. Bennett invited you to classify your queries, 1, 2, 3, 4, &c., and he would answer them *seriatim*. I did not number my queries, but I put several very direct and unmistakable enquiries in my letter beginning p. 462. Have these been answered either by Mr. A. R. B. or his followers? The questions were practical and they have

received no answer. Why? Because they were not numbered? Surely not. Again, the inference is obvious.

With regard to the letters of Mr. A. R. B.'s followers: in the first place the Whitehaven district is entirely out of it on the same ground as has already been quoted, viz., the comparison of Paris and Peebles and Galashiels and London.

Mr. Poole thinks it follows that on a call wire system the operators should each be able to attend to more subscribers than on an indicator system. This, as things are, is not the case, and but for Mr. Poole now being in the service of a competing company, I should be very happy to tell him why.

Mr. Poole's third paragraph is a simple begging of (or off) the question, and I do not propose to treat it seriously. He has *not*, however, yet shown that all the subscribers beyond a break on Bennett's electrostatic call-wire are *not* cut off, and I maintain that they *are*.

Coming to his sixth paragraph, Mr. Bennett was not the first, by a very long way, to adopt a horizontal board. The important points he (Mr. Poole) points out cannot be claimed as due to Bennett, Poole, nor the Mutual, and he must excuse me stating that I question very much whether he is right in saying that Bennett's "multiple board is *the* one for dealing with a very large number of wires."

Mr. Poole says that my objection to the condensation of switchboards no doubt holds good in regard to non-multiple switchboards. I go further and assert, and am prepared to prove, that it *does* apply to *all* switchboards, non-multiple or multiple. I ought not to teach Mr. Poole, but on this point perhaps the National will overlook my doing so. My objection, it may be mentioned, was that "the switchboard must not be so condensed as to prevent the requisite number of operators getting access to it."

Mr. Poole is welcome to his opinion that a combination of the call wire with multiple switchboards and metallic circuits is the one best adapted to grapple with the difficulties of the telephoning of a large city, such as London.

With reference to disconnection from exchanges having mixed systems, if you will give the matter a little further consideration, you will, I think, see that the further step (c) does not alter in any way my contention. In such a case all concerned will be no worse off, but, on the contrary, all the better off, for a call-wire system at one or more of the exchanges. I shall be happy to go into this further if you desire; meantime I am considering your space.

I hope that some one of your transatlantic readers will respond to your request. If so, I shall at once take a back seat if they can prove my returned main call-wire to have been anticipated. I am sure, however, you will credit my statement that my improvement was made without the slightest knowledge of its having been previously attempted or accomplished.

I now reach Mr. Somerville's letter. He, I am sorry, must have a weak memory. The conversation he refers to *did* take place, but at a date prior to the introduction of the call-wire at Aberdeen, and when he was in charge of a non-multiple indicator system of approaching 500 subscribers with one switchroom and no trunk wires.

Very few *do* understand the Mutual board, nor shall they, until it is described by someone who has seen and understood it.

I have already hinted at the futility of the "ideal of the multiple system" in combination with my returned call-wire for *very* large exchanges, and I am not going to enlarge on that to please anybody.

In your issue of the 30th ult., Mr. A. R. B., like the policeman, is still not found when wanted. *Nominally*, Mr. F. F. B. comes first. It seems to me that if you have only 1·047 square feet to each operator, it is almost if not quite impossible to distribute it—bearing in mind the 99 operators in contiguity—in such a way as to enable her to have access to it.

It is strange that Mr. F. F. B. should have so intimate an acquaintance with the Mutual board, considering that, so far as I am aware, he is engaged in electric lighting at some little distance from Manchester. At any rate he states that the number of operators for his brother's board for 5,000 subscribers, is 50. That means 100 subscribers per operator—leaving junctions, &c., wires out as if they had no existence—and again it becomes a question of what is considered a good service.

Mr. Kingsbury (p. 520) hits my mark exactly, viz., that W.E. and Mutual jacks occupy a space practically the same. There is nothing therefore that Bennett or the Mutual can do (or, so far, have done) that cannot be done by anyone else if, indeed, it has not already been done.

With reference to Mr. Poole's letter on the same page, I happen to be in London and am therefore unable, conveniently, to refer to the prior correspondence in your columns. I am pleased, however, to see that he bears me out that you "must not condense your switchboard so as to prevent the requisite number of operators getting access to it," whether (I may add) your boards are multiple or non-multiple.

The W. E. Co. are quite right to be alive to the importance of a reduction in size—within certain well-defined limits.

Mr. P. says, in referring to ring-off indicators, that I might also have excepted his special one adopted in the National Company's Manchester exchange. To think that, in these days of magneto bells, a ring-off system requiring batteries is worth entertaining, is simply absurd. If you do adopt such a system, it means that you must have a sufficient battery power at each subscriber's office to drop the call-off indicator at the exchange.

If there is anything more than another which I can *not* stand, it is Mr. A. R. B. arrogating to himself or the Mutual anything which they are not justly entitled to. That is what he has done, and that also is why I have entered this correspondence.

In reply to Mr. Goodwin, p. 520, his diagram undoubtedly shows a *Mann* call-wire, p. 492, but he will remember my letter was based on his own wording, and before his diagram appeared. He need hardly get sarcastic with me. Mr. Bennett took some liberty with Mr. G's name, p. 408; if I may be permitted to do the same I should say that Mr. G. has scored a *good win* over Mr. A. R. B. If Mr. G.'s call system was in use in India in 1883, that does not anticipate Mann's, which as I have stated was certainly working in Dundee in July, 1882.

Jno. D. Miller.

November 4th, 1891.

[We are sorry that we are compelled to curtail Mr. Miller's letter owing to lack of space, as well as on account of somewhat irrelevant and libellous statements.—EDS. ELEC. REV.]

I have to request that you will kindly allow me a little more space in your columns.

Mr. Goodwin appears to be a peculiar individual. In his letter, dated September 5th, he writes: "I simply asserted that up to the present no one (to my knowledge) had any experience of metallic circuits on a large scale, which statement I reiterate." When it is shown how limited his experience was by pointing out the Paris exchange, he first ignores it, and then, in his last letter, says: "I do admit that Paris represents telephony on a large scale, but I do not admit that Paris is worked on a call-wire system." His statement as given above, and the one on the same subject in his first letter, had no reference whatever to call-wire systems, but simply to metallic circuits.

Again, who would have thought that *phone* meant a *table*? If a bell was used in the Indian exchanges during the day, very little regard was given to the subscribers, and it is no wonder such a plan be given up. There is only Mr. Goodwin's unsupported testimony in regard to its being the "Mann" system of call-wire which was used in India in 1883, and the weight of evidence is altogether against him; I think it due to your readers that he should give a drawing of the switch used in connection with the call wire on the subscribers' instruments. This would at once show what was really the system of working.

I have to thank Mr. Kingsbury for his valuable information. I was apparently misinformed in regard to the New York switchboard. I do not agree with him that a horizontally-worked switchboard cannot have a large ultimate capacity. Under the conditions by which they are practically worked, I believe that as large a board could be manipulated by operators sitting at a horizontal board as by others standing at a vertical one with indicators.

J. Poole.

November 9th, 1891.